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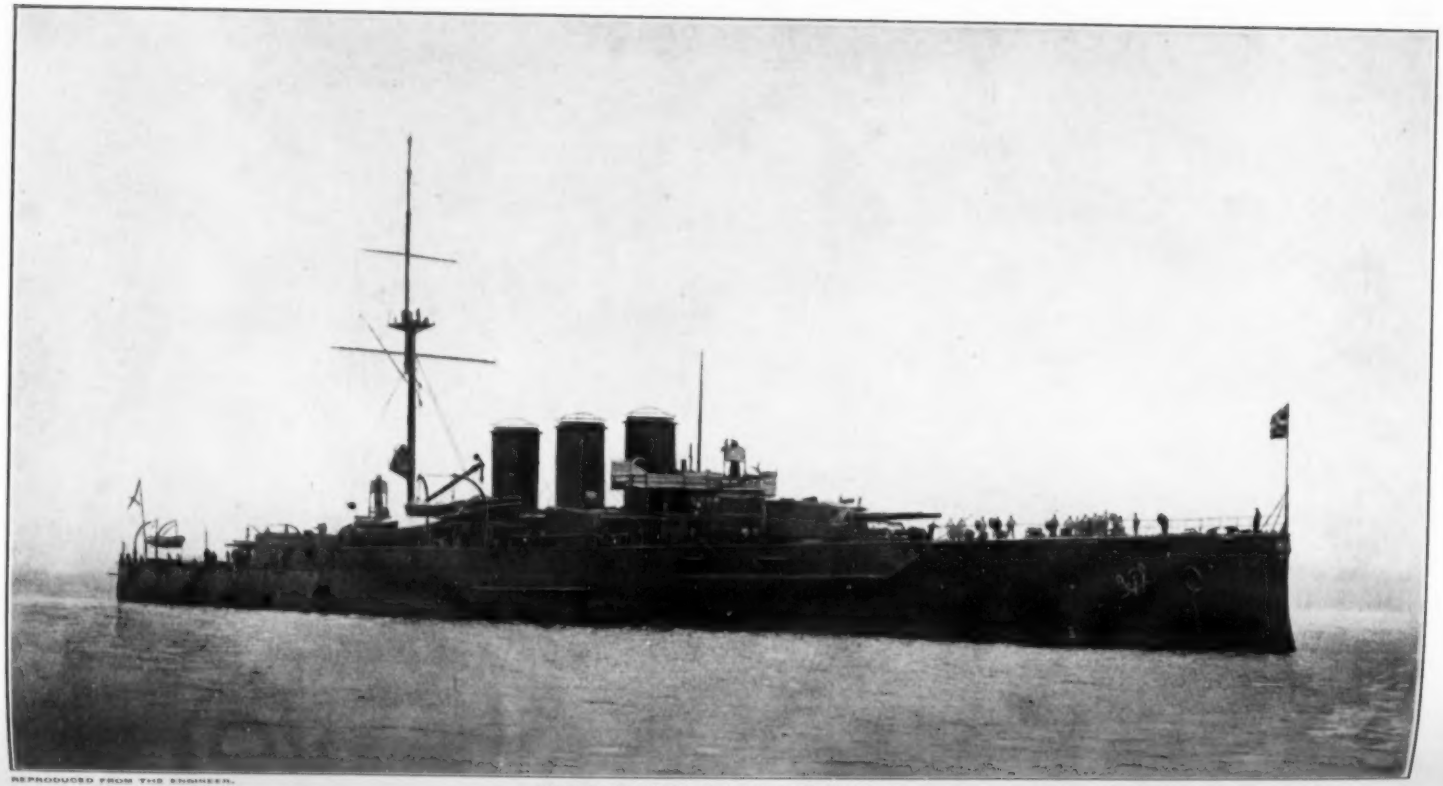

REPRODUCED FROM THE ENGINEER.

THE ARMORED CRUISER "RURIK."

UNITED STATES NAVAL INSTITUTE PROCEEDINGS.

Vol. 34, No. 4. DECEMBER, 1908. Whole No. 128.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

GAS *VS.* STEAM FOR MARINE MOTIVE POWER.

By CAPTAIN A. B. WILLITS, U. S. Navy.

The tremendous strides made in recent years in the development and application of the gas engine and producer to power plants on shore, both in this country and abroad, and the recognition of the actual economies in cost of operation and in heat transformation resulting from the use of such an installation in place of the usual steam plant, incites a present close inquiry into the possibilities possessed by the former for meeting, in its present stage, or even in a modified form, all the requirements of the power plant of a battle-ship.

There is a popular notion, born of enthusiasm in the realm of the gasoline motor, that the smokeless, stackless, ocean "steamer" is soon to be realized on the other side, and that we are very far behind other nations in progressiveness along these lines; but while it is very true that our government has not made systematic study of the problems surrounding the adoption of the internal combustion motor to high powers afloat, nor expended funds in serious experiments thereon; nevertheless, there has been no lack of interest in such results as has been from time to time made public by those who have taken active steps towards ascertaining "what there is in it."

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There is a popular notion, born of enthusiasm in the realm of the gasoline motor, that the smokeless, stackless, ocean "steamer" is soon to be realized on the other side, and that we are very far behind other nations in progressiveness along these lines; but while it is very true that our government has not made systematic study of the problems surrounding the adoption of the internal combustion motor to high powers afloat, nor expended funds in serious experiments thereon; nevertheless, there has been no lack of interest in such results as has been from time to time made public by those who have taken active steps towards ascertaining "what there is in it."

From the very beginning of the use of the gasoline motor in small craft we have as fully recognized the difficulties and objections connected with the radical change from steam, as we have the advantages. A safe rule in mechanical engineering is to always look first for the objections and errors in new designs before enthusing over their merits, but as, usually, it is the successful performances alone that are given out to the reading public, the popular view is generally ultra-optimistic and valueless as predicatory judgment. The novelty in mechanics is always attractive to the layman, who is, of course, unable to see more than the obvious; but what is characterized as non-progressiveness on the government's part is often a delay due to the knowledge of serious barriers to continuously successful and economical operation of new devices.

In the gas-engine plant ashore we have at least sufficient demonstration of efficiency and points of superiority over the steam engine outfit as to excite reasonable curiosity as to why it should not equally apply to ships; and the actual installation, of two or three years ago, of a suction-gas outfit in the yacht *Emil Capitaine* and its successful operation in the Solent, together with the more recent installation of a 500 B. H. P. plant of somewhat similar design in the little English gunboat *Rattler*, by William Beardmore & Co., Dalmuir (part owners of the *Capitaine* patents), have proven that, with anthracite coal, the scheme is in a measure successful for small powers. These are the only real steps thus far taken towards bringing the two systems into a shape for fair and careful comparison, although they do not yet so bring them.

STATUS OF THE MARINE INTERNAL COMBUSTION MOTOR.

Before presenting the obstacles in the way of the adoption of the gas engine and producer as a substitute for the steam outfit let us take a brief glance at the status of the marine internal combustion engine itself, using other fuels as well as gas, so as to eliminate whatever "impossible" features there may be, in the consideration of future installations of large powers.

MARINE GASOLINE MOTORS.

The all-familiar "motor boat" engine using explosive fuel mixtures, has undoubtedly come to stay. In low powers, with gasoline, it has demonstrated its desirability beyond question both

as an auxiliary power to sailing craft and as a drive for pleasure boats, tenders and dories. A moderate degree of care in storage of the gasoline and in preserving the integrity of pipes and fittings appears to relieve the situation of the dangers usually associated with that fuel, while the wide distribution of the supply of gasoline throughout the world renders it as easy to obtain as coal, so long as the demand remains within comparatively moderate limits.

The great mass of the small-power motors are of the 2-cycle type, cheap in construction, expensive in fuel consumption per B. H. P., but inexpensive as a total daily cost for the comforts and advantages obtained. As these motors advance in size or power the questions of cost and total fuel consumption, as well as of motor weight, assume serious proportions. The simple expansion of the 1-cylinder 2-cycle design which answers well for a 2 B. H. P. would not only bring in a 100 B. H. P. motor an unusually clumsy and heavy cylinder and crank shaft but also necessitate an almost inadmissible fly-wheel to effect its operation. Besides this the cost in fuel would be excessive over that of a 4-cycle multi-cylinder motor. Hence it follows that the growth of the gasoline motor has been in the multi-cylinder and 4-cycle direction, involving the use of both inlet and exhaust valves, mechanically operated, and a system of proper distribution and control of the ignition of the mixture in the several cylinders; this also demanding more care in maintaining proper adjustment of the carburettor and the equal supply of the mixture to the various cylinders without " robbing."

The weight question has been ably handled in this country by the use of high grade steel in open frame-work, shafting, etc., and aluminum compounds for base castings where great stress was not imposed, until a 6-cylinder 500 B. H. P. motor outfit (double-acting type) can be built weighing not more than 15,000 lbs. or 30 lbs. per B. H. P. for a speed of not less than 300 R. P. M.

Several departments of the government have experimented with gasoline motors, purchasing a large number of the smaller sizes for use in tenders, yawls and barges, and the Navy Department has extended these tests to the design and manufacture of certain small motors and to the purchase and installation of several up to 300 B. H. P. for yard craft or ferry launches, while the submarines, built or building, have gasoline motors from 160 to 500 B. H. P. units. All this experience, however, has not encouraged

great advance in power in the general use of gasoline instead of steam, except for special service where steam cannot be used. It has rather indicated a limit of about 50 B. H. P. as advisable; for while the use of the lower powers has been eminently satisfactory and their superiority over small steam plants distinctly obvious, troubles and disadvantages show up in using the big motors for this fuel, and particularly when of light construction.

Primarily when the power is increased there are added difficulties in the way of starting. The usual hand "cranking" of a small motor becomes an arduous task in a 75 B. H. P. size and from this upwards, for these operations, compressed air with the additional complications involved, is quite necessary. Troubles also increase through lack of intelligent handling and the fact is too often overlooked that an ordinary first-class fireman or watertender, well qualified to handle the steam plant of a cutter, cannot, simply by reason of such skill, successfully operate a 75 B. H. P. gasoline engine. There are numberless little causes for the balking of such machines, and a thorough comprehension of the theory upon which the motor operates, the system of wiring and ignition, and the mechanical peculiarities of the special type in hand will alone avail to preserve efficiency and to avoid a general "snap shot" condemnation of the entire apparatus.

Again, when we come to the larger sizes, the actual total daily consumption of gasoline makes the rather wholesale handling of it necessary and exhibits very plainly the excessive costs of fuel. For instance the 300 B. H. P. motor will consume about 40 gallons an hour, and if run at an average of three hours a day would require more than two barrels of gasoline. The price, of course, varies at different points, but we can estimate this at approximately $15.00 a day, while a steam plant capable of giving the same service, could be operated on about a ton of coal (stand-by losses and all) at a cost of not more than $3.00.

Furthermore it was found that these larger motors in a confined engine room were excessively hot and noisy, even to a distressing degree. The noises from valve gear and exhaust are surmountable troubles, but as found in the examples tried were immoderate. There is lacking in such comparatively slow-running motors that continuity of exhaust which accompanies the use of the automobile motor of high R. P. M.; and muffling in an effective manner is not as simple. Reversing can be done by clutch so as to keep

the motor constantly running in one direction, as is done in smaller sizes, but this is far from perfect and cannot be considered advisable, even with hydraulic type of clutch, so that compressed air is also quite necessary for this duty and reversing gear, in valve cams and shafts, must be installed. A hand-operated reversing propeller was very satisfactorily tested out at Norfolk and appears to be far preferable to any cluch for the smaller powers, but would probably be impracticable for 300 B. H. P. size.

In spite of these objections. however, the gasoline motor may be said now to be a mechanical success up to 500 B. H. P. units of 5- or 6-cylinders. This is a cylinder rating of 80 to 100 B. H. P. as a present limit and of course implies the possibility of adding more cylinders of same size, when other conditions permit. Improvements in details are matters in hand by builders awaiting only the incentive of a demand for these high powers sufficient to warrant the cost of initial work and the necessary large scale experiments.

The fuel question, however, rises up as a real barrier against extension. Not only is the actual cost great and excessive, but the wholesale handling of gasoline brings its added dangers and objections. The cost will rise still further with increased demand, and an unlimited supply could not be relied upon at all parts of the world or even in our own country. The fluid and volatile nature of this fuel renders it unstable in the full sense of the word, while the implacable intensity of its burning, should it catch afire, presents a real danger far more realizable in such bulk and on such large craft, than it either is or is imagined, in the small boats.

ELIMINATION OF FUELS.

From the above it can be seen that the temptation that was held out to us by the first consideration of the many advantages to be gained in adopting the gasoline motor for our torpedo craft and at one stroke getting rid of our steam-boilers, smoke-stacks and smoke nuisance; increasing the steaming radius and reducing the number of men needed for engine force, as well as the arduousness of their work; was not strengthened by our experience, nor by full consideration of the fuel question. Indeed it is evident that gasoline must be eliminated as a possible future fuel except for small craft. The heavier oils must also come under the same ban, for while these oils are safer to carry, their use in the internal

combustion engine is more difficult and involved, and the limit of visible supply as well as certain increase in price with increased demand, keeps them out of the category of universally available and economical fuels. These heavy oils have, however, a most important part to play in supplying marine motive power for special craft—in generating steam—but not for general use even in that manner. True it has been considered quite safe to build a few war craft fitted only for burning oil in the steam-boiler furnaces, but this line of procedure has already been realized as having distinct limits and it is not probable that hereafter, either here or abroad, many oil-fuel installations will be made without retaining the features of ready alternation with coal.

Alcohol is the last liquid fuel to consider for internal combustion engines, and its possibilities are certainly far greater than those of other liquid fuels, as well as of its own probabilities. This fuel is superior to gasoline in so many particulars as to make it, with proper cheapening, quite certain of universal use where gasoline now holds sway. In spite of its lower thermal value it has been shown, in motors specially designed for its use, to give almost equal B. H. P. output (pound for pound) as gasoline. It is susceptible of much higher compression than is the latter, without danger of pre-ignition, it diffuses more readily in forming a uniform mixture with the air charge, and it has a far wider range of "proportions" of mixture, over which it can be exploded. Also it has the great advantage of being readily extinguished when free burning, by application of water, a difference from gasoline akin to the difference between safety and danger. A slight pre-heating is necessary when starting from "cold" conditions, but all mechanical difficulties connected with its use have been overcome. To fully realize the highest economy the motor for alcohol must be specially designed in order to secure the higher compression with proper volume. It is not sufficient to simply raise the pistons of the gasoline motor to reduce clearances. In very small motors, should alcohol succeed gasoline, this would no doubt be done, but otherwise the alcohol motor would have to replace present installations of the other type. Gas engines, however, are built for the higher compressions and there was such real cause for concern and alarm on the part of the gas-power interests as to create their earnest antagonism to the cheapening and extensive production of alcohol. With a sort of international

encouragement of such production it would seem possible for this fuel to some day reach the position of an economical standard throughout the civilized world, but for the present generation at least, and in view of the still unlimited and widely distributed supply of bituminous coal, we are forced to view the latter as the only one possible to consider as future fuel for general marine purposes, universally available and economical.

THE COAL-POWER PROBLEM.

The present method of using coal for obtaining motive power in the form of steam, utilizes in useful work, or as near to it as we can come in brake horse-power, only between 10 and 11 per cent of the heat value of the fuel, under the best circumstances in marine turbine machinery, and even less than that with reciprocating engines. Improvements in the latter type embodying multiple expansion, use of higher pressures, superheating the steam, decreasing clearances, and reducing engine friction by adopting vertical cylinders, has made it possible with careful firing to obtain our power at a cost considerably below 2 lbs. of coal per I. H. P. against from 4 to 6 lbs. per I. H. P. demanded by the simple machinery of thirty or forty years ago.

As an illustration of the present economy we will take the trial data of the *New Hampshire*, as published in the Journal of the American Society of Naval Engineers of May, 1908, whereby it is shown that a total of 17,267 I. H. P. was obtained on a coal consumption of 29,932 lbs. per hour. As we find it quite impracticable to satisfactorily "indicate" the power of the gas engine in the cylinders, as we have always done in the case of the reciprocating steam engine, we must depend upon methods for securing the actual power delivered to the shaft, or the brake horse-power—and for comparison of the two types as well as with turbines this will be used. The *New Hampshire's* brake horse-power will approximate then 15,100, and the coal cost is therefore about 1.98 lbs. per B. H. P.

The coal used was Pocahontas with a heat value of approximately 14,800 B. T. U. and, assuming 2545 B. T. U. heat equivalent of a horse-power, we have represented in useful work on the shaft, 8.6 per cent of the potential of the fuel. This with the latest type of reciprocating engines at full power.

With turbine engines, at full speed, the percentage of heat trans-

formed into useful work from the fuel is considerably greater, and in the case of the big Cunarder *Lusitania* we have published data showing as low a coal cost as 1.43 lbs. per B. H. P. per hour. Many engineers are, however, inclined to be somewhat skeptical as to the accuracy of the measures made of the powers of this vessel, but we do feel quite safe in assuming an economy rate of 1.6 lbs. per B. H. P. for comparative purposes. This implies about 10.75 per cent of the heat value of the fuel converted into useful work; or 1.29 times the percentage of that so converted by the *New Hampshire's* machinery at full speeds.

For our purpose of comparison with the gas engine, only the economies at full designed speed of the different types of engines need be used, especially as the gas engine does not suffer in comparing the lower points of the curves of coal per B. H. P. hour.

As we have ample data for stating that, with the gas engine and producer, using coal of equal calorific value as we do on our ships' trials, we can secure a B. H. P. from one pound or even less of coal at full load, we find our percentage of heat utilized in useful work raising to 17.2 per cent and our full power radius practically double of that of the reciprocating engine and 1.6 times that of turbines. It is this element of economy therefore that primarily brings the producer-gas engine up for serious consideration.

THE GAS ENGINE.

While we have stated that the gasoline engine is actually a real factor only in units of comparatively low power, we cannot say that this applies to the gas engine on shore.

The discovery of the utility of the weak gas from the blast furnace, as motive power in an internal combustion engine, was the incentive to build large gas engines and transfer into useful work a part of the enormous quantity of this gas previously absolutely wasted. Also in those regions where natural gas (the richest of all fuel gases) was found in abundance this encouragement equally existed, because the low fuel cost relieved the status of the internal combustion engine of the draw-back due to the cost of gasoline, or fuel oils.

In proceeding to develop the larger engines, however, the first snag encountered is that due to the enormously increased volume of heat necessary to get rid of. As the cylinder diameters increase the volume of the gas used and the heat units developed

per stroke increase far more rapidly than do the exposed surfaces through which a sufficient amount of the total heat at each explosion must be transmitted and carried off by cooling jacket water, to keep down the temperature of metal and prevent pre-ignition of the following charge, as well as to permit proper lubrication.

The temperature of explosion averages about 2300° F. and unless rapid cooling is effected pre-ignition is inevitable and also piston and valve troubles in excessive friction, scoring, etc., which soon destroys the motor's efficiency.

The next trouble experienced is in the accommodation for necessary expansion of the parts under such rapid and excessive changes of temperature; from 2300° F. at explosion to 1000° F. at exhaust, and also for proper strength of the larger heads to sustain the great pressure. The ordinary pressures in the gas engine cylinders are enormous compared with steam, the compression pressure being as high as 180 (averaging 120) and the pressure at explosion being about 425 lbs. per square inch, delivered as a blow.

The consequence is that while successful horizontal gas engines are built for blast-furnace gas and natural gas, up to units of from four or five thousand B. H. P. in multi-cylinder form, and cylinder diameters rose in a few cases to as much as 52 inches, the weights become enormous, and immensely heavy fly-wheels of very large diameters are necessary for preserving uniform rotation. The question of balancing the engine, however, prevented any great increase in size of the vertical type, the weight of the moving parts in this type increasing the irregularity of the stresses in journals and requiring even greater sizes of pins and fly-wheels.

The use of the double-acting principle and horizontal type of engine together with using two tandem cylinders on the same piston rod enabled the builders to simulate the steam engine in securing an impulse or power-stroke at each piston stroke, arranging the 4-cycle to properly alternate, and by making the pistons as well as stroke longer, a fairly good water-cooling of pistons, cylinders, heads, valves and piston rods was effected.

Nothing whatever in all this advance was in line with meeting marine requirements, nor did it show a particle of encouragement to those studying the marine problem. In a 600 B. H. P. Cockerill engine, single cylinder and single acting, 52 inches diameter and

56 inches stroke, and operating at 90 R. P. M., we find the total weight to be 279,400 lbs. or over 465 lbs. per B. H. P., against 65 to 70 lbs. for battleship engine-room weights. The fly-wheel alone weighs in this case 66,000 lbs. This single 600 B. H. P. gas engine weighs more than the entire engine-room weights of a turbine destroyer of 10,000 B. H. P., *i. e.*, 279,000 lbs. against 250,000 lbs. for the destroyers' entire engine-room machinery. The double-acting Korting type of 550 B. H. P. weighs but 164,000 lbs. or about 300 lbs. per B. H. P. and this appears to be about the average low limit for the shore type of gas engines, even in smaller sizes; so that in designing for marine work we cannot advance beyond our 500 B. H. P. motor previously noted, upon any lines laid down by our commercial brothers on land.

There has, singularly enough, been no very large engines built for producer gas. That is there are no producer gas engines built as high as 1000 B. H. P. sets. This rather goes to prove that, as a commercial proposition, where fuel cost is a factor, great cost of the larger units and the difficulties involved in successfully operating them, makes the smaller-sized cylinder engines only appeal to the producer gas-power interests, and we find the diameter limits of the vertical gas-engine cylinders to be about 19 or 20 inches. There are none being built at present larger than that, in this country at least, and I doubt if anywhere abroad.

This brings us to the viewing of the engine installed in the *Rattler* as of the largest type of vertical gas engines, and yet also built on marine lines; and while we do not consider this particular engine in any way extraordinary nor one which we cannot now excel in motors designed and built in this country (such as the standard double-acting reversible type) we can take it at least as a proved 500 B. H. P. installation of 5-cylinders at the present upper limit of cylinder diameters.

By permission we quote from an article by the Marquis of Graham, in the current number (November) of *Cassier's Magazine*, a few lines on the *Rattler* installation, and would add in addition thereto that the weight of the installation is 90 tons or 400 lbs. per B. H. P., so that there is nothing very favorable in that point. The original machinery was designed for 1000 H. P. full power and weighed 150 tons, so that the present installation of 500 B. H. P. naturally saved total weight, and it will be well to note at this point that the entire weight of the machinery of a modern battle-ship, including boilers, auxiliaries and appur-

tenances is, for reciprocating type, but little over 200 lbs. per B. H. P. and for Parson's turbine type about 155 lbs. per B. H. P., while in the destroyers of the latter type this weight is down as low as 55 lbs. per B. H. P.

H. M. S. *Rattler* is one of the old British gunboats, lent to the Clyde division, R. N. V. R. Her description is as follows: Composite construction; single screw; length, 165 feet; beam, 29 feet; mean draft, 11 feet, 2 inches; displacement, 715 tons; indicated horse-power (forced draft), 1000 = 13 knots; natural draft, 600 = 11.5 knots. The ship was launched at Elswick, Oct. 8, 1886. Her old steam engines, boilers, etc., have been removed and a single set of vertical Beardmore-Captaine suction-gas engines and producer installed in their place.

The machinery of H. M. S. *Rattler* consists of a 5-cylinder, single-acting suction-gas engine and producer of 500 brake horse-power, the cylinders being 20 inches diameter by 24-inch stroke, revolutions 120 per minute. This engine, owing to its special construction, can be considered the most suitable type of internal-combustion engine of large power for marine work. The engine frame is built of steel plates and angles, thus giving a very strong and rigid machine with a minimum of weight, cast iron being only used for the cylinders and cylinder heads. Each of the five cylinders is independent of the others, so that if desired one engine may be shut off and valves, etc., examined while the four remaining cylinders are working. A magneto is fitted to each cylinder, the ignition being of the low-tension make-and-break type. This type of ignition is especially adapted for marine work where so much moisture is met with, which can do serious harm where there are high-tension leads. During the whole commission of H. M. S. *Rattler*, both this year and last year, the ignition has been unfailing. Forced lubrication is used for the cylinders, and the engine being of the open type, the main bearings, bottom ends and gudgeon pins are lubricated by hand.

The gas generator of the usual type for using anthracite coal is a steel shell, lined with fire-brick and provided with a feeding hopper on the cover, this cover being water-cooled. The fire-bars are trough-shaped and placed radially around the producer. The inner ends are supported on a tube; water is kept circulating through this tube and so prevents the burning away of the edges of the fire-bars.

The cleaning plant is comprised of cooling tower, centrifugal drier and cleaner, and these occupy very little space.

The gas after leaving the producer, enters the bottom of the cooling tower and leaves at the top. The gas in its upward course comes in contact with water sprays and is thus cooled and cleared of any grit that may be in it. After leaving the cooling tower, the gas passes to the centrifugal drier in which the fan is revolving at a high rate of speed, and any water that is in the gas is thrown off to the walls of the casing and drained therefrom to a water seal. The gas being lighter remains at the center of the fan and is then drawn through the cleaner to the mixing valve on the engine and thence to the various cylinders. The cleaner is a square box filled with

perforated plates, packed closely together. The gas enters at the bottom and rises diagonally to the top, and on its passage impinges against the plates and thus removes any dirt or water that perchance may still be in the gas. The plates in the cleaner are perforated in a special manner to give the best desired results.

The exhaust, after leaving the cylinders (the exhaust valves and inlet valves are water-cooled), passes through casings which may be termed boilers. These effectively silence the exhaust. These casings or boilers contain a nest of tubes through which water is circulated, and the hot exhaust passing around them generates the steam that is used in the producer.

Reversing is effected by means of a hydraulic clutch working through an epicyclic train of wheels. The engine is started by means of a mixture of gas and air pumped up to a pressure of 95 pounds per square inch, which is admitted to the cylinders through a specially constructed valve and then fired. This compressed mixture can be used with perfect safety without any fear of back-firing, as the mixture cannot be fired until the admission valve is closed. The engine invariably starts up with the first impulse and gets sufficient way on to draw in the gas from the main mixture pipe; then by this time the starting mixture valves and tappets have been automatically closed and thrown out of gear by the governor.

In regard to the actual performance of the vessel, the *Rattler* has run, up to date, 1800 miles; and it is well within the mark to say the average speed attained has been 8 to 9 knots. Under natural draft as a steam vessel, the *Rattler* did not run at greater speed, and under forced draft the records of her performances, if ever they existed, are lost in antiquity.

H. M. S. *Rattler*—as a steamship—had an engine room and stoke hold complement of seventeen hands, being four engineers, and thirteen stokers. As a gas ship, she runs easily with a complement of seven, being three engineers and four producer attendants; but the functions of the latter can easily be done by seamen, since attendance on the producer entails but a few minutes' work every two hours.

The above installation on the *Rattler* has also a small steam boiler for auxiliary purposes and a single smoke-stack, both objects which we hoped to be rid of. In fact the outfit is an experiment merely, and one from which simple lessons only are learned. The producer used is for anthracite coal only, and does not solve the bituminous problem or the riddles for the fire-room, while the motor is heavy and of the single-acting type, which could never count in the high-power compact machinery demanded by the weight and space allowance in war ships.

PRESENT LIMITATIONS OF THE MARINE GAS ENGINE.

From what we have shown it would appear that for our 16,000 B. H. P. battleship or our 12,000 B. H. P. destroyer gas plant, we would have to use a large number of cylinders of small diameter.

Many people have an idea that it would be simply a matter of coupling on these 500 B. H. P. units until we got the desired power in a ship, but let us look at this point for a moment.

Take for instance a 16,500 H. P. battleship like the *New Hampshire*. We cannot, with our reciprocating engines, run at the high R. P. M. of the turbine, because our revolutions are limited by a certain piston speed which we consider mechanically limited to about 1000 feet per minute. With cylinders 20″ x 24″ we could therefore only run as high as $\frac{1000}{4} = 250$ R. P. M., and as for transmission of our power we probably could not use the small screws of a turbine effectively we could not well distribute the power on more than three shafts. Let us assume then that we use only 5500 H. P. or at most 5000 B. H. P. on a shaft.

We will suppose we are to install the slow-speed motors of the *Rattler*—say for 125 R. P. M. as stated. In such units we would have to put 10 on each shaft, or 50 cylinders, occupying about 15 feet each, or 150 feet of length engine on each shaft. Incidentally it might be here remarked that the engine room of the *New Hampshire* is only 44 feet long between bulkheads.

But aside from the impossible length and the absurdly large number of cylinders to look after we would find trouble in our shafting adjustment. Our 500 B. H. P. S. A. motor has a crank shaft of course much larger than a 500 H. P. triple expansion steam engine on account of the necessity of providing for the excessive initial pressures, but the first or forward set in the 10 on each shaft would merely require a proper shaft for its own power. Each following set or unit, however, must have a shaft capable of transmitting not only its own power but that of the units ahead of it, so that when we would come to the aftermost set we would find it necessary to use a shaft large enough to transmit the entire power of the 10 units to the propeller, so that the simple addition of a fixed size of 500 B. H. P. units will not satisfy the conditions.

By modifying the American design of 500 B. H. P. gasoline engine in 6-cylinder units of double-acting type we could probably get our 5000 B. H. P. on about 100 feet of shafting or bed line, still far more than twice the length available, and even if we distributed our power on four shafts, our bed plates would be 70

feet long; but we would have even more cylinders to look after in these cases and can readily imagine the resultant pandemonium.

THE PRODUCER.

In citing the possible limitations of the use of the gas engine afloat we are not to be led away from the very obvious attractions of the gas producer, for it would appear that its use in place of the steam-boiler would bring as great a transformation in the fire-room as has the turbine engine in the engine room.

As at present constructed, however, we find but little accomplished towards meeting ship requirements and it is therefore equally necessary for us to look carefully at these extant designs and see what encouragement they offer in the way of general possibilities for a final efficient and practical marine suction-gas plant for supplying all the power we can utilize in our future gas engines.

We use the term suction-gas in order to eliminate the pressure type of producer from our consideration, because for ship use the pressure type, wherein the gas is generated under a light but distinct pressure, would always present the danger of gas leakage into the compartments, even with all precautions taken. The toxic properties of CO are too strong to run such risks and while encasing the gas piping with the air pipe supplying the producer has been pointed out as a solution of the difficulty in adapting the pressure producer to the service, it is only partially so and is complex in practice. Besides this the suction-gas producer is far preferable in many other points, especially in economy in gas production for in this method the gas is only made as demanded by the engine. Of course this is not strictly true but in running conditions the air supply to the producer is only such as is created by the suction of the pistons of the engine cylinders and the production of gas is thereby controlled. Even if we use an "exciter" or suction fan between the engine and producer we must locate this fan in close proximity to the engine so as to keep the producer and pipe lines under less than atmospheric pressure and prevent all tendency to outward leakage. Our ideal is then to be a bituminous suction-gas plant pure and simple; pure CO as far as we can manage to get it (if we believe in Mr. Tait's carbon monoxide scheme) and as simple as possible, and while we will reduce our conclusions to the inclusion of only this type we will briefly note the general status of the commercial gas producer as we find it.

While many other features besides economy cause the marine engineer to pore over the producer problem and desire to secure a complete solution, the one item of less cost of the production of a B. H. P., both in fuel, attendance, interest and upkeep, alone make a market for the gas plant ashore. In burning coal by direct firing in a furnace, for the production of steam (for we will not deal with the metallurgical side of the subject) we find it wholly impracticable to secure complete combustion owing to the impossibility of controlling the air supply to anywhere near the amount theoretically required to accomplish it. With the periodical firing in furnaces there is a constant fluctuation in the condition of the fuel-bed, and with bituminous coal this is aggravated. This is due to difference in thickness, caking, clinkering, ash formation, etc.; while the very processes of slicing, spreading or pricking add to the variations. Provision for a great excess of air over that actually required must be made in spaces between grate bars in order to secure enough at times of fresh firing to burn the most volatile gases effectively. This excess of air dilutes the gases and reduces temperatures, besides actually transporting considerable ungasified fuel at such times up the stack when using finely divided coals, such as the run of bituminous, while a far greater loss of heat through ashes and in waste of fuel dropping through grates, is experienced in direct firing than in producer firing.

In the producer we can control the supply of air almost perfectly and instead of completing combustion of the fuel there we carry it only to the point of gasification and draw the gas off, mainly in carbon monoxide form, lead it to our engine and there complete the combustion to CO_2 by admitting sufficient air to make an explosive mixture and firing it usually by the electric spark after proper compression.

The operations in the producer can but be partially compared with the functions of the steam-boiler as until the gas is completely burnt in the cylinders the fuel heat has not been fully transferred So that this primary efficiency in obtaining a more complete combustion of our fuel does not more than indicate one of the advantages of the producer. When the heat losses of the two systems are compared clear through to the final amount secured in useful work we can see more clearly the enormous waste still beyond our capture or control and can sense the great distance separating us from the perfect heat engine. In the producer gas engine out-

fit we find the heat losses in per cent of the calorific value of the fuel to be approximately as follows:

Lost in producers	10%
Coolers and scrubbers, etc	10%
Jacket losses	30%
Net loss in exhaust	33%

Making a total loss of about 83 per cent and a net useful work of 17 per cent. While in the ordinary steam plant we can as fairly approximate the lines to be:

Boiler losses, radiation leaks and ashes	10%
Smoke-stack, losses in	20%
Auxiliaries and pipe lines	5½%
Engine losses	7%
Condenser losses	49%

Making a total of 91.5 per cent loss and leaving 8.5 per cent for useful work.

While the sum of the two greatest losses in the steam plant (condenser and stack) is not far from the sum of the two greatest losses in the gas plant, we must note that owing to the very high temperatures at which the exhaust gases leave the latter (over 1000° F.) we can readily adopt means for recovering more waste heat in the gas plant than we can do in the case of the steam engine, and while not actually returning it to useful work in the motor we can, on shipboard, undoubtedly divert it to the heating system or evaporators and directly realize its value in saving fuel otherwise necessary to expend.

As to the general principles in which the producer operates so much has been and is being published as to make the steps familiar to all who take any active interest in the subject and the "quantitative and qualitative analysis" of the B. T. U. variations and distributions need not be given here. It will suffice to touch upon the leading features and keep in mind the approximate analysis and heat values of anthracite, semi-bituminous and bituminous coals. These are in percentage:

	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.	Heating value per lb. in B.T.U.
Anthracite	3.09	4.28	83.81	8.18	.64	13220
Pocohontas Semi-Bit.	1.00	21.00	74.39	3.03	.58	15070
Bituminous	1.37	35.90	52.21	8.02	1.80	13410

The distinctive difference between anthracite and bituminous being that the latter's high per cent of volatile matter includes such hydro-carbons as tar, etc. which are not present in anthracite and the elimination of which from bituminous coal gas is the real "Bogey."

The principal object of the gas producer is to generate gas free from non-combustible carbonic acid, thus sending all the carbon in the fuel out in CO form, by which means it will bear a heat potential of the full value of the original carbon less the heat lost or set free in the producer in effecting the first oxidation. If some complete oxidation takes place the CO_2 thus formed is inert and useless in our engine. To some extent this always does occur in producers, but the best of those using hydrogen (from steam) as a diluent, claim to be able to keep this down to about 6 per cent, while by the carbon monoxide method this is stated to be as low as 1.75 per cent. Obviously with a very deep fuel-bed the escape of gas in the CO_2 form becomes more difficult, but even then the fire level must be kept well below the top of the fuel and an almost impossible control attained so that in practice the above 6 per cent is held to be an excellent showing.

It will be as well here to give the typical analysis of a few of the gases so as to have a clearer guide to what we wish to note below:

Commercial Power Gases.
Constituents per cent by Volume.

	Combustibles.					Non-combustibles.			
	H	CH_4	CO	C_2H_4	Total %	CO_2	N	O	Total
Natural Gas	3.0	92.0	0.0	3.0	98.0	0.0	2.0	0.0	2.0
Bituminous (producer) ..	13.0	5.0	15.0	0.2	33.2	7.3	59.0	0.5	66.8
Anthracite (producer) ..	15.0	2.5	20.0	0.0	37.5	8.0	54.0	0.5	62.5
Blast Furnace Gas.....	2.5	0.0	25.0	0.0	27.5	11.5	61.0	0.0	72.5

We note in this that only 33.2 per cent of the volume of bituminous producer gas is combustible and also that there is 59 per cent of uncombustible nitrogen in the same gas; and we naturally look for an explanation for this, as well as why such a large part of the 33.2 per cent of combustible should be hydrogen when we were just stating the desirability of a large proportion of CO.

In using air for oxidizing the fuel carbon there is necessarily included the admission into the gas of 3.8 volumes of N. to every volume of O. If air alone was used for this oxidation we would have a still larger percentage of N. than is shown in the table and, besides having a resultant weaker gas we would have a higher

temperature in our fire-bed and producer than is desirable. By using steam with the air we accomplish three objects:

First.—We reduce the temperature in the fire-bed by the amount of heat necessary to decompose the steam into its elements H. and O., this decomposition being accomplished through the contact of the steam with red-hot carbon.

Second.—As the liberated O from the decomposed steam unites with some of our fuel carbon to form CO we reduce by an equivalent amount of air the quantity of the latter necessary to use per pound of fuel and consequently its burden of undesirable N.

Third.—We enrich our gas by the calorific value of the hydrogen gasified, and can pass it on to the motor cylinders for final combustion together with the CO.

The reduction of the temperature of the fire-bed plays a most important part in preventing clinker in using the caking coals and in this respect is a large factor in the successful operation of a bituminous coal-gas producer.

The producing of good gas is a process far from simple as from the above we can infer the necessity of having the producer carefully proportioned. The design cannot be hap-hazard, and, to imagine it a ready possibility to bring the producer to more compact form in order to suit the fire-room space limits of our high-power ships is to ignore the size requirements to efficiently "burn" the desired amount of coal per hour for our needed B. H. P.

We alluded above to the "carbon monoxide" method whereby the CO_2 in the gas was kept below 2 per cent. This is a distinct type or method of procedure and eliminates the use of steam entirely, bringing in a feature of special interest to the marine engineer. As the process can be used in connection with any producer it has additional claims to our serious consideration and a brief outline of its principle of action will be given. The originator is Mr. G. M. S. Tait, president of the Gas Power Company, of New York, and a brochure on the subject can be found in *Cassier's Magazine* of July, 1908.

Instead of using steam as a diluent of the entering air, as commonly done, a portion of the exhaust gases from the engine is returned to the producer for this purpose—about 3 per cent of this CO_2 gas I am given to understand is thus used—and it is claimed to effectively reduce the temperature of the fuel-bed in the same

manner as does the steam, the excess O uniting with C to form CO.

The elimination of the hydrogen is also claimed to obviate the great fluctuations in the quality of the ordinary producer gas, and to produce a most uniform product, having a straight CO composition of combustibles and a gas having the advantages of a fixed ignition point. True this gas is weaker than the composite gas enriched by hydrogen, but it is susceptible of much greater compression without danger of pre-ignition and the possibilities are worthy of study and of test in marine design. The writer witnessed the operation of this system in connection with a R. D. Wood & Co. producer (at the John Thomson Press Works, Long Island City), where it was giving highest satisfaction in operating a 150 B. H. P. engine. This plant is clearly illustrated in Mr. Lewis' article in the number of *Cassier's* above alluded to.

There are also two other claimed advantages of the above system which should be noticed—one is that the pulsating effect of the exhaust gases from the engine results in a beneficial shaking action on the ashes and keeps the air streams well distributed. While the absence of hydrogen prevents, with coals containing considerable sulphur, the formation of H_2SO_3 which acid is always corrosive in its action in heaters and appliances for the recovery of heat from the burnt gases of the exhaust.

The commercial type of gas producer is made in various sizes up to 500 B. H. P. units and no doubt can be made of double that capacity if required, but from mechanical considerations a 350 B. H. P. units is about the ordinary upper limit. Most of these producers in the east are designed for using the cheap pea or smaller anthracite siftings and are thus operated at both minimum expense in outfit and trouble in handling. The small percentage of hydrocarbons in anthracite eliminates necessity of greater care in gas cleaning than passing it through a static scrubber, and its non-caking character involves but little stoking.

In this character of producer and for small powers the entire plant can be made as nearly self-running or automatic as any one could wish. For instance the Pireka Chocolate Company, in Brooklyn, N. Y., run their manufacturing machinery by a 40 B. H. P. gas engine and an anthracite producer. In the morning the ashes are hauled to bring the slumbering fire-bed within a proper distance from the "grate" line, 450 lbs. of anthracite buckwheat

coal is charged, the engine is started by compressed air (accumulated during the day in a storage tank, by a connected pump), and in a few minutes the plant is in full swing and no attention whatever is given to the producer until the next morning. It is just "wound up" as it were for a ten-hour run of the machinery and a sleep over night. The whole installation is so extremely simple, compact and efficient as to make one wonder why the extension of such plants is not more rapid. But this is an anthracite-using plant also and is given simply as a pleasing illustration of possibilities under certain conditions.

TROUBLES WITH PRODUCERS.

In handling successfully bituminous coal in the producer we are confronted with difficulties in two distinct forms:

First, in preserving a uniformly porous fuel-bed entirely across the producer and second, in getting rid of the dirty hydro-carbons, principally the tar, which if passed on to the engine would quickly clog valves and pistons and bring the operations to a close.

The caking qualities of most soft coals necessitates very frequent "poking" to prevent its arching in conglomerated mass across the producer and impeding both the descent of the fuel and the free passage of the air through the bed, or its clinging to or shrinking from the fire-brick lining, both causes of trouble and inefficiency. The breaking up of the caked masses by poke bar frequently causes blow holes through which a large part of the air will rush without doing duty.

Various methods for effecting uniform work in this class of producer and securing a clean gas without the usual wide fluctuations in its quality are constantly being devised and experimented with, all as yet without completely satisfactory results. Revolving grates, automatic stirrers, and mechanical feeding apparatus, each has its particular point of merit as well as its practical objections and the ideal is still unreached in producers yet on the market.

Schemes for the elimination of the tar, however, are effective in securing a gas with but two one-hundredths (.02) of a grain of tar per cubic foot of gas, by the use of static scrubbers (tall cylinders nearly the capacity of the producer, filled with coke over which water is continually showered and through which ascends the gas from the producer) which cool and partly clear the gas and further by rotary scrubbers and extractors, which consist of

apparatus containing revolving wings and baffles through which the gas then passes and wherein it is thoroughly agitated together with a water spray, and the remaining tar almost entirely abstracted.

From a marine standpoint this removal of the tar is the most important difficulty encountered in the bituminous producer and while the method described, when properly working, would possibly clean the gas to a degree that would give little trouble in the engine, this constant efficiency would have to be absolutely certain before we would dare to risk its application to a ship's engines. In steam we have no properties which involve reasonable doubt of maintaining the engines in a continuous state of readiness for service, but with a tarry gas not only would the engines be "hors-de-combat" in short order but the work of frequently dismantling and cleaning would be something too herculean to even contemplate.

Elimination of tar by burning appeals more strongly to the engineer than does the operation of scrubbing it out of the gases, both from a physical and chemical standpoint, and the simplest form for this would be a down-draft producer. But the down-draft principle increases the troubles in preserving a uniformly porous fuel-bed owing to the flow of the air and gases being in the same direction as the gravity descent of the fuel and the resultant "packing" of the fuel-bed and formation of clinker causes frequent shutting down for cleaning out and absolutely prevents uniform gas production. This principle has therefore not been successfully practiced and there is no continuously-operative down-draft producer using bituminous coal in use up to the present time.

A very ingenious combination, however, of the up- and down-draft has been put upon the market quite recently by the Westinghouse people and is claimed to be continuously operative and a success with bituminous coal. In this design the lower half of the producer is fire-brick lined, inverted, truncated cone while the upper half is cylindrical. At the point of juncture of the two figures the section is wider (for a foot or two) than the diameter of the cylinder, so that the descending fuel does not completely fill up the particular portion but leaves a vacant ring from which space the gas is drawn off. The hottest part of the fire is in the belt line and a water-box surrounds it in such a manner as to make a suffi-

cient boiler to give all the necessary steam to mix with the air used in the producer. This entering air and steam is delivered both beneath and on top of the fuel body and thus all the gases are passed through the hottest part of the fuel before going to the scrubbers and thus the tar is consumed. Even in burning the tar in this way there is a residuum of lamp-black to eliminate before the gas is fit for the engine, but this is so thoroughly washed out as to give practically clean gas. This washing is done by passing the gas from the producer through vertical pipes of large diameter (16 inches in a 350 B. H. P. producer) into which quite a number of small pipes spray water at regular distances apart, primarily to cool the gas and secondarily to wash out a part of the lamp-black. The gas then passes through a water-pan scrubbing box which completes the cleaning and it is then lead to a mixing tank for preserving as far as possible uniformity in the gas delivered to the engine.

We have no data of actual performance of this design but outline it to show in what directions progress is attempted for just as long as difficulties exist in the way of accomplishing desirable ends in the field of mechanics, just so long will talent turn to the conquest, even with little incentive beyond the gaining of the laurel wreath.

A still later form than the above-mentioned producer has been invented by Mr. William B. Chapman, New York, which appears to have points of very great excellence towards the overcoming of nearly all the bituminous coal troubles. The writer is not permitted to more than outline this producer at this time, but the idea is impressively of merit, although its practical working must be left for the time being unjudged.

Where uniform feed and mechanical stoking can be secured a greater rate of coal consumption per square foot of cross-section (or grate) can be effected economically and as this reduces the weight of a producer per B. H. P. inventions accomplishing this are particularly interesting to the marine engineer.

The Chapman producer is a fire-brick-lined cylinder in four sections erected between four fixed pillars. The upper section is fixed on these columns, and contains a hopper of half the diameter of the producer, located on and just including a radius of same and descending 3 feet below the producer-top, or the full depth of the fixed section, and also extending considerably above the pro-

ducer. The next section of the producer is a revolving one supported by a circumferential angle plate resting on rollers which are fixed on the columns. This section is joined by water seal to the upper section as well as to the next lower section. The latter is quite short and fixed, while the bottom section is a revolving one of similar construction as the upper, barring the hopper; its lower end rotates in a fixed water ash pan and from the center of this ash-pan base rises the air inlet nozzle casting to a height of about 2 feet. This fixed air nozzle has projecting arms forming sort of up-lifting ploughs and its head is cast in a diamond shape for clinker crushing. The nozzle is conical so that the descending ashes are pushed outwards to the opening between the bottom of the lower section of the producer and the bottom of the ash pan and they well up in the outside portion of the ash pan, which is filled with water. By removing part of these ashes the ash level is maintained at just above the top of the air nozzle, and is easily judged by looking through peep holes at that level.

The operation is as follows: The revolving sections are rotated at a very low expenditure of power by means of worm and worm wheel and gear meshing in the teeth on the supporting rings, at a speed of two revolutions per hour for the upper and one revolution an hour for the lower section. The fire-bed level is kept at the top of the upper revolving section by the hopper delivery nozzle being at that level. This hopper is cut shorter on one side so as to present its longest side to the advancing fuel and act as a surface scraper and leveler and prevents surface caking, while the fuel feeds down automatically from the hopper as the coal is consumed and bed lowers. As the fuel-bed descends it does not revolve during its passage through the short fixed section but does again revolve, though but half as fast, in the lower section, thus a twisting strain is given to the fuel which effectually prevents all blow holes even if the draft is forced, and also keeps the fuel from shrinking from the sides of the producer. The action of the ploughs at the upper part of the ash bed gives an uplifting effect which prevents tendency to clinker and the ashes are delivered in a finely divided state to the ash pan. The hopper is also large enough to form a coking chamber and as it is charged but twice a day it is effective in provision for eliminating a great portion of the tar in the following way: From near the hopper top a pipe is led to the fixed section between the rotating

sections at a point directly under the hopper. As the draft through the fuel-bed is not vertical under the hopper, all the gases distilled within the hopper are drawn in through this side pipe and carried diagonally through the incandescent fuel, and the tar is thereby consumed, it being claimed that by the time the coal leaves the hopper it will have lost the major portion of its tar so that after becoming fully in operation the gas delivered will be quite clean, and the scrubbing necessary will be reduced to a minimum. There is no real grate to this apparatus, the weight of fuel resting on the ashes and these on the ash-pan base. The hood of the inlet nozzle and the plough arms serve as a means for distributing the entering air and this combined with the revolving fuel-bed, makes it possible to spread the air blast more evenly in the fuel than in any previously exploited arrangement.

If this apparatus proves wholly successful it will probably reduce the producer weights considerably for it is claimed that 25 lbs. of coal per square foot of cross-section can be consumed against about 12 in the ordinary hand-stoked producer. Also the production of a gas of a more uniform quality is indicated by the uniform firing and spreading of the fuel, but undoubtedly it will be necessary for safe engine use to include the usual rotary scrubber and extractor as well as a static cooler and cleaner, to make sure the cleanliness of the gas. As yet no accurate data of weights are available.

As to actual weights of the shore plant we note that of the Westinghouse 350 B. H. P. producer alluded to is about 100,000 lbs., or 285 lbs. per B. H. P., against about 110 lbs. for fire-room weights of a battle-ship, or 30 lbs. for destroyers. The apparatus is 15 feet high by 9 feet 4 inches diameter; the mixing tank is 18 feet high by 9 feet diameter, and with cooling pipes and washers would take up about 350 square feet of floor space, or 1 square foot per B. H. P. Four times as much as the battle-ship fire-room units and working spaces.

It may be interesting to give the detailed weights of a 350 B. H. P. bituminous suction plant of the best standard make, on the usual principle to see just where they are distributed. These figures are approximate and furnished by courtesy of the R. D. Wood Company, the leading lights in the gas-producer field. Of course no attempt has been made in these designs to fit them for close quarters—weight and size cutting but small figure when

compared with the reduction in coal cost per B. H. P. in the shore plant. While with us these are the points first to be considered for a marine design.

WEIGHTS OF A 350 B. H. P. SUCTION BITUMINOUS PLANT.

Producer, about	14,200	lbs.
Static scrubber	9,500	"
Tar extractor and rotary scrubber	2,800	"
Piping and connections	4,300	"
Blower	400	"
Moisture separator	1,200	"
Tools and gages	400	"
Brick lining	22,000	"
Coke filling for scrubber	13,000	"
		"
	67,800	"

Or about 194 lbs. per B. H. P.

As to floor space occupied with these producers (which are presumably of the very best proportions for the work) the 350 B. H. P. plant, with scrubbers, separators and proper distances for operating and piping requires about 18 feet by 35 feet, or 630 square feet, which is 1.8 square feet per B. H. P. Should a 1000 B. H. P. be practicable the ratio of course would be less but even then it would amount to about 1050 square feet (23′ x 46′) or over 1 square foot per B. H. P. As our fire-rooms in the *New Hampshire* class gives available floor space of about 4900 square feet for 16,500 H. P. (or 14,500 B. H. P.). This is *less than one-third square foot per B. H. P.*, while in our destroyers the allowance is less than one-eighth square foot per B. H. P.

In such installations it would also be necessary to have arrangement of escape pipe for the first gases in starting fires which on shore are usually unnecessary, owing to the producers being located in the open or in the open-sided shedding, so that the entire elimination of the " smoke-stack " could not be obtained.

The question of providing for all the auxiliaries and dependencies of the ship's machinery in a gas installation involves very serious additional weights in the engine- and fire-rooms than that of the gas engine and producer proper and to which latter we compared all machinery weights of our steam plants in these compartments; probably involving some use of direct gas burning (as in a gas furnace) for water heating, in port, when the exhausts of the gas engine are not available.

Such a complete lay-out could no doubt be secured as to entirely dispense with any pressure boilers, and in recovering the heat from the exhaust gases we could combine water heaters with exhaust mufflers in such a way as to also secure far more excellent and efficient muffling system than now exists; this hot water being circulated through the heating system. Part of this heat of the exhaust gases (which leave the engine at about 1000° F.) we could continue to use also for the evaporators for furnishing drinking and wash water, and recently there has been invented a most remarkably efficient and compact device which would certainly make this practicable to a degree impossible with any apparatus heretofore used.

I allude to the new oil heater which will be adopted for heating the oil fuel of the new battle-ships and destroyers and is now being made by the Schutte and Koerting Company in Philadelphia. Essentially it is a corrugated tube within another corrugated tube, the outer diameter of the smaller being but a fraction of an inch less than the inner diameter of the outer tube, but, by making the corrugations spiral, the course of the gas or steam and of the fluid to be heated is facilitated and the tubes can be readily separated, for cleaning, as will at once be perceived. This spiral form of the corrugations is the whole point of the invention and there is nothing simpler conceivable for combining greatest efficiency in transfer of heat with greatest compactness in apparatus. The water to be heated is pumped through the space between the tubes, and the heating gas (or steam) passes through the inner tube. A very large percentage of heating surface is in this way afforded by the corrugations, and the liquid to be heated is in what may be called film form, of such a thin layer as to quickly absorb heat to its full capacity. It is a mere matter of proportioning nests of such heaters for excellent muffling of the exhaust and to secure an ample supply of hot water for heating the ship, in gas-engine plants.

The dynamo plant would of course have to be enlarged to a capacity equal to supplying the steering engine, anchor engine, fans and other auxiliaries with motive power and the dynamo engines would be gas-driven motors. Separate gas engine pumps for bilge or wrecking pumps and fire pumps would be advisable, as one producer would always be in use.

In fact the planning for efficient auxiliary plant presents no

serious obstacles but does form a most interesting proposition for the engineer, so that wherever an efficient gas plant for the main motive power of a vessel is practically applicable the securing of a satisfactory heat and power distribution for the balance of the machinery can undoubtedly be accomplished. Coal direct would probably be used in galleys and gasoline, alcohol or oil motors, for ships' boats.

CONCLUSIONS.

The foregoing brief presentation of the status of the suction-gas producer and gas engine covers the general conditions as they exist to-day. Rumors here and there are ever recurring of new forms of apparatus which clear the way to perfecting the marine gas plant, but there is no difficulty in speedily tracing these to unmaterialized suggestions or raw ideas.

Ashore, the producer for anthracite is in excellent and efficient form, but for bituminous coal it is not wholly satisfactory for engine use although operative in many parts of the country. For neither anthracite nor bituminous coal is the producer sufficiently compact for marine installations in such spaces as could possibly be allotted on high-powered war vessels, nor is there any belief among experts that it can be made so upon present lines. This is principally on account of the nature of the fuel and the necessity of preserving the proportions of the producer practically as now used.

The gas engine is in the same condition of unfitness in points of weight and space occupied, as we must remember the net weight of the motors even of the express type mentioned, is but a part of the engine-room weights that would accrue in complete outfit. The mechanical obstructions to use of large cylinders are as real as would be the difficulties encountered in efficient care and operation of a large number of units, and the latter idea is further impracticable from the space-occupied point of view.

Also in the light of present experience with turbine machinery, we would indeed be loth to turn again to reciprocating engines without more than a promising outlook and this we are wholly unable to perceive, as yet, in the marine gas engine.

In vessels, however, of low power and large machinery spaces, it would seem a most reasonable proposition for at least a large scale trial, both for the purpose of finding out by practical expe-

rience just how efficient a lay-out could be devised, and for securing these certain "pointers" towards improvements which can only be secured during or after such experiments.

There is no question but that a collier could be fitted out with a plant of this kind up to 1000 B. H. P., with a fair assurance of successful operation and a coal consumption of little more than half that of the steam plant. This would be a sane expenditure of money on the part of the government with a guarantee of such results as would put us in the advance line of progressive engineering, and at the same time give us most valuable data.

In respect to future forms of the gas plant we cannot with certainty make prediction, nor do we believe that invention will fail to conquer all obstacles. Much thought is being constantly given to the subject by men of high mechanical training and engineering ability and the "dream" of the producer gas turbine may, with more knowledge of material, yet become a reality. The question of a suitable blading material to withstand the intense heat of combustion is as difficult as is the subject of distribution of the gases.

As for the producer itself there is already patented a device for a pulverized fuel-gas producer which, if practicable and efficient, would increase the rate of combustion to possibly ten times that of the regular type. This idea is to inject a part of the coal, in pulverized form (and most of our bituminous coal on shipboard is generally in this state) with the proper amount of air, into a small producer, effecting first complete combustion, and then through other injectors, located above the first one, supply, in connection with steam or exhaust gases, sufficient additional coal to produce reduction of the first-formed CO_2 to CO. Thus dispensing with the large fuel-bed and body of the ordinary producer and bringing the size and weight of the apparatus at once down to such low figures per B. H. P. as would fit the plant for installation in high-power vessels. This idea has been in mind for several years and was considered a very hopeful one by some engineers of the writer's acquaintance, but Mr. Elderd's patent, issued late in October of this year, is the first detailed scheme we have met with.

Should it work out practically the anxious eye would center on the motor alone and no doubt with proper incentive much will be done to reduce the disqualifications of this principal element in the plant.

But only people of experience in experimental machinery-building can appreciate to any proper degree the amount of thought, time and money necessary to the successful exploiting of even an excellent mechanical device, let alone the development of merely a good idea up to an effective unit. Ignorant enthusiasts are often so impatient at apparently slow progress made on lines of primary great promise as to withdraw their support at the very time it is most needed and, as inventors proverbially have lean purses, many diamonds of great worth are buried in the Patent Office.

Governmental encouragement and assistance in building and testing patented apparatus which would be useful in its departments (and as judged so by a competent board of expert officials), would save to the mechanical world many excellent improvements and would make good repayment by the privilege of its unencumbered government use. But the naval branch of the government is sadly lacking in systematic experimentation on serviceable scales. There are many reasons for this defect and there are many more regrets that it is so.

In the gas-engine field there is much to learn now and very much to improve upon, but just so long as the radical changes indicated as necessary remain "in the air" will the high-power producer gas marine installation be impossible.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE PRESENT PHASE OF THE PERSONNEL QUESTION.

By COMMANDER ROY C. SMITH, U. S. Navy.

The immediate issues involved in this question have been greatly confused by discussions of theoretical or normal conditions, which, owing to a variety of causes, have no actual existence at this moment. The present navy list happens to be in a very abnormal condition as regards numbers and distribution. As a result, many features of theoretical measures for the regulation of a normal list have no application to the actual list. This, however, is no disadvantage; but on the contrary it makes it possible to omit all such features, retaining only those that are essential, thus resulting in greater simplicity. The idea in this is that we must deal with actual conditions; and as it happens the actual conditions are such that the remedy is far simpler than if the conditions were normal.

Looking at the service to-day, it appears that a number of young officers are banking up at the foot of the list as graduated midshipmen or ensigns. With 200 graduates a year there will be in a few years nearly 1000 such officers (two classes of midshipmen and three of ensigns). On the other hand the grade of lieutenant, junior grade, is empty. It would seem reasonable to move bodily the senior two classes of ensigns into the grade of lieutenant, junior grade. This could be done by a law making ensigns eligible to promotion to lieutenant, junior grade, three years after their graduation from the Naval Academy (instead of three years after final graduation as now).

There seems to be no trouble at present with lieutenants and lieutenant-commanders. Officers are reaching the latter grade about twelve years after graduation, which is earlier by several years than has been advocated in any recent measure. Commanders still reach their grade somewhat too late, captains much

too late, and admirals only a year or two before retirement. If a measure can be devised to promote to flag rank at about 55 years of age, the ages of captains and commanders will be regulated at the same time.

There are thus two crying faults to be corrected, to distribute the young officers banking up at the foot of the list, and to promote to flag rank earlier than at present. Neither measure presents any difficulty; and if carried out, owing to the present condition of the navy list, there would be no other measure required for a generation. These facts are possibly not fully appreciated in the service; but they arise very naturally from the conditions as they exist, which will now be taken up more in detail.

Slow promotion in the higher grades is inherent to any system of step-by-step, or seniority, promotion when working normally. The following consideration shows this very clearly. Suppose there are one hundred graduates each year. Experience shows that the losses in all parts of the list amount to about 3 per cent annually. If 22 is the age of graduation and 62 the age of retirement, there will be 40 years' service. A graduating class of 100 members suffering 3 per cent reductions annually will at the end of 40 years consist of 30 members. If 30 admirals only are allowed, then all the admirals will be in the same class and all in the last year of their service. As a consequence the captains and commanders will also be old, and the conditions will be similar to those now obtaining at the top of the present navy list. The result is inherent in the system and is unavoidable unless the system be modified.

These conditions are recognized in all the navies of the world, and in all of them except ours some means have been taken to correct them. There are two general methods, selection and elimination. The former is used in the English, French and Japanese navies, the latter in the German and to some extent in the English Navy. These two methods are illustrated in Figs. 1 and 2, from which it is easy to see the essential difference in the two plans. The scale on the left is numbers in the different classes; that at the bottom average ages, assuming 22 to be the age of graduation. In both figures the ensigns are assumed to go up together three years after graduation. Thereafter in Fig. 1 promotion is by selection, in Fig. 2 by length of service. Selection to be effective must be combined with an age retirement. Thus, in Fig. 1, all

lieutenants not selected by the age of 40 are retired, lieutenant-commanders at 45, commanders at 50, and captains at 55. No rear-admiral can thus be over 55 on reaching flag rank, and the youngest may be only 45. Captains may be as young as 36 but not older than 55. Commanders may be between 30 and 50, and so on. There is thus a wide range of ages in each grade. In Fig.

Fig. 1

Selection

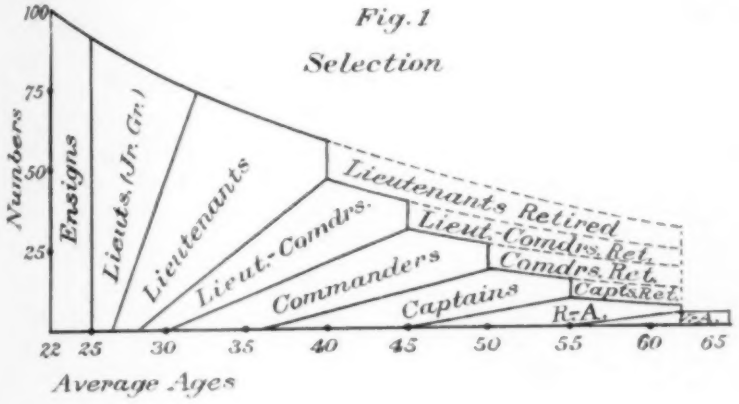
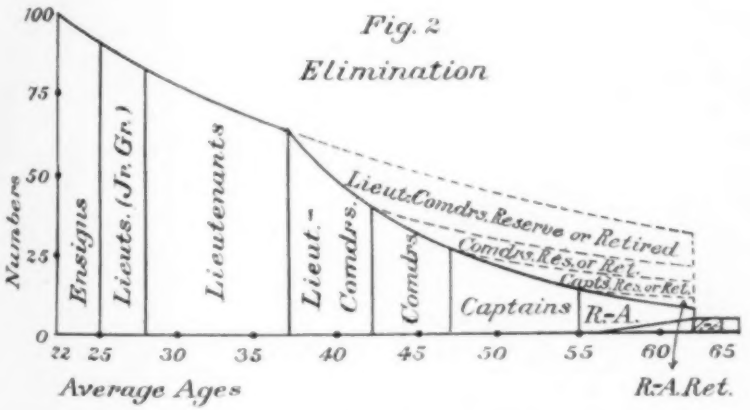


Fig. 2

Elimination



2 elimination begins in the grade of lieutenant-commander. In this and the higher grades there will ordinarily be an excess of numbers, due to promotion by length of service from the grade below. Each year such excess is eliminated from the whole grade by a process of selection-out. Promotion by length of service ensures that all officers shall reach their grades at a reasonable age.

The arguments for and against the two methods are briefly: Selection is more like the conditions in civil life; it offers a great incentive to exertion, it brings able men to the top while still young. The disadvantage is that the older officers in each grade know they can go no higher and have lost hope. This counterbalances the increased efficiency of the younger men in the same grade, and there is no improvement on the average. The method presents many advantages, but is usually dreaded for fear that favoritism may count for too much in the selections. Elimination has the advantage, besides the more complete adaptation of age and experience to rank and duty, that the process of selecting out the least efficient raises the average of those that remain, and there are no heart-burnings in the active service. There is still room for selection, but selection of a different order, that is selection for duty and command. All the officers in a grade are able to do the duties of the grade; but for any special duty the officer most fitted for that duty is the one to be selected. In either of these plans the least efficient suffer about the same. But in selection, many are left on the active list who have been passed over one or more times and are disheartened. In elimination, all who remain on the active list still preserve their old seniority and each one of them has still a chance to go to the top. This method appeals more strongly to the service itself than that of selection.

It might be supposed that either of the above methods, by increasing the retired list, would increase also the expense. This does not follow. Under the present system nearly all officers retire as senior rear-admirals at the maximum rate of pay, which they continue to receive for their expectation of life, about 13 years at the age of 62. Under either of the other methods working normally there would be few retirements at the maximum rates, but quite a large number at lower rates, and the total cost of the retired list might be no greater. In the method proposed by the writer in the NAVAL INSTITUTE PROCEEDINGS for September, 1906, the cost of the retired list is actually reduced.

The methods adopted in the foreign services mentioned are briefly as follows:

Promotion in the British Navy in the lower grades is entirely by selection. Through the grades of captain, rear-admiral, vice-admiral and admiral, it is by seniority, but again by selection to admiral of the fleet. The ages of retirement are as follows: ad-

mirals of the fleet, 70; admirals and vice-admirals, 65; rear-admirals, 60; captains, 55; commanders, 50; lieutenants, 45; sub-lieutenants, 40. Elimination obtains also in a measure. If an officer remains unemployed for three or three and one-half years, according to the grade, it becomes necessary for him to retire.

The French method is combined selection and seniority. Two-thirds of the promotions of ensigns are by seniority, one-third by selection; of lieutenants half by seniority and half by selection; and in the higher grades all by selection. The retiring ages are: vice-admirals, 65; rear-admirals, 62; captains, 60; commanders, 58; lieutenants, 53.

In the German Navy promotion is by seniority, with elimination of the unfit, or those whose services may no longer be required.

In the Japanese Navy promotion is exclusively by selection, but in the grade of captain it follows quite closely the order of seniority. Below captain selection is very free. The retiring ages are: admirals, 68; vice-admirals, 65; rear-admirals, 58; captains, 53; commanders, 48; lieutenant-commanders, 45; lieutenants, 43; junior lieutenants and ensigns, 38.

From what has been stated earlier in the paper, it becomes clear that the unsatisfactory condition at the top of the present navy list can be corrected only by the adoption of some such plan, selection or elimination, as has been described, and as has been found necessary in foreign services. As there did not seem to be any difficulties in the middle of the list, the remedy will be all the simpler in its application.

Before inquiring into the exact form of the remedy, it may be well to examine a little more fully the actual condition of the navy list. Fig. 3 shows it graphically. The dotted line is similar to the curves of Figs. 1 and 2. It represents the desired present strength of the various classes to give a suitable number of officers of suitable length of service for each grade. The full line represents the approximate present strength of the classes; that is, it is a more or less smooth curve drawn through the points representing the actual strength of the classes. The remains of the old "hump" are seen at the right, rising above the normal curve. Then comes a "trough," below the normal curve, consisting of the graduating classes from '80 to '04, twenty-five classes in all. Finally the new "hump" is to be seen at the left, composed mostly of the present double classes, the last of which will enter in 1913.

The "trough" was occasioned by the legislation of 1882, limiting the appointment of graduates to the number necessary each year to fill the existing vacancies. The new "hump" was the result of the legislation of 1903, which became necessary to correct the legislation of 1882. The new "hump" will eventually be about sufficient to fill the "trough" to level. The existence of the "trough" is what makes promotion so satisfactory at present

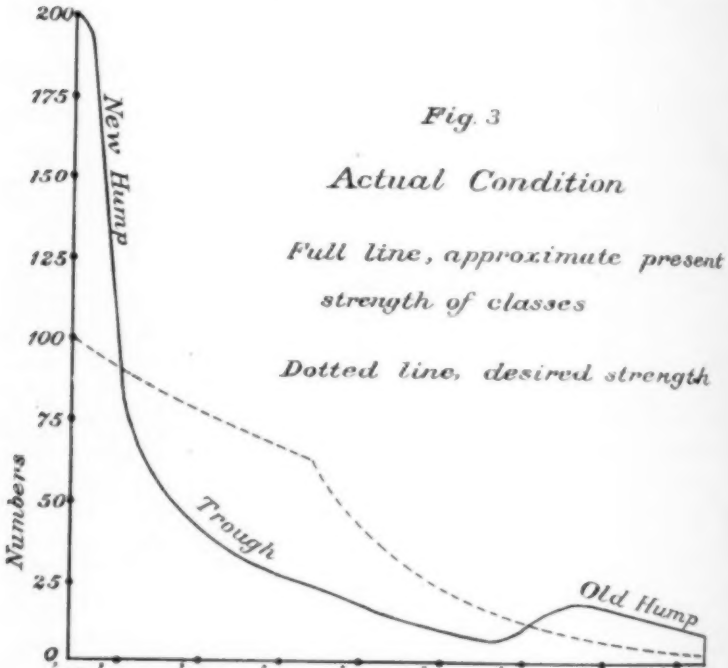


Fig. 3

Actual Condition

Full line, approximate present strength of classes

Dotted line, desired strength

throughout the middle of the list. The classes composing it were depleted by the legislation of 1882 beyond the possibilities of any scheme of selection or elimination that could ever be advocated or desired. Ten or twelve years from now, when the "trough" reaches the top of the list, promotion will be as satisfactory all through the list as it is now in the middle; and there will be no necessity for either selection or elimination. This condition will continue while the "trough" is passing, after which the new "hump" may possibly have to be considered; though this is not

probable, as the natural expansion of the navy in this time will be apt to absorb it. At any rate it is not a question that affects this generation.

The problem therefore reduces itself to this: For the next ten or twelve years how may admirals be promoted early enough to have a reasonable length of service in their grade before reaching the age of retirement? From Fig. 3, the remains of the old "hump" are seen to be the only obstacle. Here then is an occasion to apply some form of selection or elimination; and there is no alternative, except of course to leave things as they are. The method by selection would be to select the admirals from the captains and then gradually reduce the age of captains by a progressively diminishing age retirement, beginning at say 60, and then reducing by a year each year until 55 should be reached. This would be the simplest method of all, but is open to the objections previously enumerated as applying to the method of selection.

The method by elimination would be to promote two precedence dates of captains each year until the date should be reached averaging nearest to 55 years of age, and thereafter at least one date each year, irrespective of the resulting number of admirals, selecting out the excess, if any, from the whole list of admirals. At the end of about six years by either plan the average age of the senior captains would be brought down to 55 years. Either plan would cause the retirement of quite a large number of captains or rear-admirals. The age of the present captains averages from 53 to 60, and about fifty of them are already over 55.

In the matter of expense, there would be no difficulty, but on the contrary a financial gain. It may be shown that each captain retiring as a junior rear-admiral would save the government on the average about $20,000. The principal reason is that most of them now retire eventually as senior rear-admirals at the maximum rate of pay; and taking into account the expectation of life, as well as other accompanying circumstances, the resulting gain from retiring in a lower rank is found to be about as stated.

An expedient that might prove of immediate value would be a law permitting captains 55 years of age or over to retire at any time at the discretion of the President as junior rear-admirals. The operation of the present personnel law may force a certain number of captains onto the retired list each year as commodores. Allowing them to go voluntarily as junior rear-admirals, at the

same rate of pay, and with a large eventual saving to the government through their not reaching the grade of senior rear-admiral, might prove an advantage. A captain hesitating as to his course would much prefer to go out voluntarily, say in January, as a junior rear-admiral, than to be forced out in June as a commodore.

The next matter requiring attention is the proportion of the total force in the various grades. Some years ago when the total, including graduated midshipmen, amounted to about 1000, the total of the grades down to and including lieutenants was fixed by law at 750. The total of all ranks has now increased to 1400, and we still have 750 down to and including lieutenants. So, in 1913, the total will be about 2000, and we shall still have 750 down to and including lieutenants, which will leave 1250 below that grade. This is a condition which of course nobody defends. It has simply grown so because it has never been changed.

The remedy is obvious. It is to distribute the grades in proportions of the whole. In deciding on proportions there is a tendency to take into account only commissioned officers. There is a certain disadvantage in this method, which is as follows: All the graduates of the Naval Academy, whatever their rank, are available for duty. Their number is known, and varies from year to year by new graduates less total casualties. The number of commissioned officers is the same as the above less the number of graduated midshipmen. The number of graduated midshipmen is subject to fluctuation. It is now about 400, normally it is nearer 200, and in case midshipmen should be made ensigns after a year's service, or immediately, it would vary again. All this time the total has been varying only slightly.

Hence it is evidently better to make the proportions relate to the total and not to the commissioned officers only. This can easily be done by lumping all the grades below lieutenant, whatever they may be called. Thus, "The total of all the officers below flag rank including graduated midshipmen shall be distributed in the grades as follows: 5 per cent captains, 6 per cent commanders, 16 per cent lieutenant-commanders, 40 per cent lieutenants, and 33 per cent in the remaining grades; provided that ensigns shall be eligible to promotion to the grade of lieutenant, junior grade, three years after completion of the four years' course at the Naval Academy; and provided further than none of the present grades shall be reduced in numbers."

The following tables would show the effect of such a law for the next five years:

EXISTING LAW.

Rank.	1909	1910	1911	1912	1913
Captain	70	70	70	70	70
Commander	112	112	112	112	112
Lieut.-Commander	200	200	200	200	200
Lieutenant	350	350	350	350	350
Below Lieutenant	784	903	1019	1130	1238
Total	1516	1635	1751	1862	1970

PROPOSED LAW.

Rank.	%	1909	1910	1911	1912	1913
Captain	5	75	81	87	93	98
Commander	6	90*	98*	105*	111*	118
Lieut.-Commander	16	242	261	280	297	315
Lieutenant	40	606	654	700	744	788
Below Lieutenant	33	503	541	579	617	651
Total	100	1516	1635	1751	1862	1970

* Less than present number, which retain.

Taking the numbers of the proposed law as above for 1913 (July 1), the junior captain would be of the graduating class of '85, the junior commander of the class of '94, the junior lieutenant-commander of the class of '04, the junior lieutenant of the upper part of the class of '10, and the junior lieutenant, junior grade, at the foot of the class of '10.

The measures that have thus far been advocated will be sufficient to put the personnel on an entirely satisfactory basis for many years to come except in one regard. There is no present method of regulating the appointments to the Naval Academy in accordance with the needs of the service. The present law of appointments, by which double numbers enter each year, will expire in 1913. It is estimated that by that time the total personnel will be adequate to the requirements. The number of entries thereafter should evidently be sufficient to maintain such relation. The present rule is that each of the nominating authorities may maintain a certain number of appointees (one, or two, and twenty at large) at the Academy. The resulting total has no logical connection with the actual requirements of the service. But there is, of course, a relation between the available ships and the number of officers and men required to man them and carry

on the other duties of the navy. This number can be readily determined at any given time. If it should then be expressed in the form of a ratio of numbers of personnel to tons of shipping, the ratio would still hold good for long periods notwithstanding variations in the total tonnage.

There are several ways of expressing this ratio. For instance, considering the line only, the personnel could be taken to include the commissioned officers only, or the commissioned officers and the graduated midshipmen, or all the officers and midshipmen, whether in service or at the Naval Academy. Similarly the tonnage could be taken to include only the warships available for cruising, omitting small craft and auxiliaries, or it could include also the small craft and auxiliaries, or it could include also the ships authorized by Congress, but not yet built. It is to be observed that at any given time, supposing the navy to be adequately manned, the actual value of the ratio would vary with whichever of the above assumptions should be adopted. This has not always been understood, as criticisms have been made that a ratio has been assumed as desirable, as for instance three officers for 1000 tons of shipping, and then all the shipping has been included, whether serviceable or unserviceable, and even the shipping on the ways. This criticism is not merited if the proper personnel is determined independently at any given time, and the value of the ratio is then deduced in accordance with the assumptions as to what part of the personnel is to be considered and as to which of the ships are to be considered.

Considering all the circumstances the results are more uniform and less liable to fluctuation if the whole personnel is included, whether in service or at the Naval Academy; and if the whole serviceable tonnage is included, of whatever character, and whether built or only authorized. If ships and personnel are authorized together, then the ships can be built while the midshipmen are passing through the Academy, and both will enter the service at about the same time. At present, in fact, the ship can be built sooner than the midshipman can be graduated.

From a consideration of our own needs and foreign practice, as well as of a number of official estimates that have been made at various times, three officers per 1000 tons has been found to be a reasonable and desirable ratio. This includes totals, all personnel, wh ther in service or at the Academy, and all the serviceable shippir ' built or authorized whatever the character.

Another reason for including the midshipmen at the Naval Academy in the total of personnel is that it gives us an immediate means of determining the proper strength of the entering class at the Academy. The total of the shipping multiplied by the ratio, less the total of the personnel, gives at once the size of the new fourth class. The normal size of the class should be about 7 per cent of the total personnel. This is enough to allow for failures during the course and provide a suitable number of graduates. The figure is deduced from past experience. To prevent too sudden variations in the sizes of the entering classes it would be well to establish limits which should not be passed; for instance, 7 per cent being the normal, 9 per cent and 5 per cent could be taken as the limits.

A slight change would be necessary in the present law of appointments. The various nominating authorities, instead of always maintaining a certain number of appointees at the Academy, would make their nominations in regular rotation to the extent that should be found necessary to fill the prospective vacancies. The proportions would remain as at present, except the appointments at large, which should be made the same as at West Point, that is, 40 at any one time. The number now allowed at Annapolis is 20 only. This plan is worked out quite fully in the article on Personnel and Promotion in the NAVAL INSTITUTE PROCEEDINGS for September, 1906, already referred to.

There are one or two other simple measures that could be desired. For instance, the ex-engineers who do not go to sea reduce the available number in any grade of officers who do go to sea. To correct this it has been proposed to make these officers extra numbers. There is ground to believe that the officers themselves do not favor such measure, as they wish to retain their status in every respect similar to other officers of the grade (except as to their duty). Both objects could be attained by temporarily increasing each grade by the number of officers in the grade not available for sea duty, without specially designating such officers as extra numbers.

Another matter is that of vice-admirals and admirals. It is contrary to military principles that the commander-in-chief of a fleet, with possibly six rear-admirals under his command, should have the same rank as they. It is derogatory to the dignity and prestige of the country that in our intercourse with other nations, or on joint commissions, or in combined operations, our admiral,

whatever the importance of his position or command, should always be outranked by a foreigner. The navies of other great powers, besides rear-admirals, have vice-admirals, admirals, and admirals of the fleet.

To conclude, the navy list is in a very unusual state; but by that very reason the measures required to regulate it become of great simplicity. Simplicity is a prime requisite in legislation. The measures here advocated are all entirely independent of each other. Any one can be enacted with advantage, and the more the better. They are, briefly:

First.—Ensigns to be made eligible to promotion to lieutenant, junior grade, three years after completion of the four years' course at Annapolis.

Second.—Captains 55 years of age and over to be allowed to retire voluntarily at any time at the discretion of the President, as junior rear-admirals.

Third.—The age of the senior captains to be gradually reduced until it averages 55 years. This to be done by a progressively diminishing age retirement, coupled with selection to flag rank; or a progressive elimination, coupled with promotion by length of service.

Fourth.—The total personnel below flag rank, including graduated midshipmen, to be distributed in the grades in percentages of the whole of such personnel.

Fifth.—The personnel to be authorized with the ships; the total personnel, including midshipmen at the Naval Academy, to bear a fixed ratio to the total of serviceable and authorized shipping; appointments to the Naval Academy to be made in regular rotation to the extent required to preserve such ratio.

Sixth.—The various grades to be increased temporarily by a number corresponding to the officers in the grade not available for sea duty.

Seventh.—One admiral to be created for each 500,000 tons of serviceable and authorized shipping, one vice-admiral for each 200,000 tons of such shipping, and one rear-admiral for each 40,000 tons of such shipping.

The above simple measures will put the personnel of the line on an entirely satisfactory basis until the new "hump" nears the head of the list, that is, some twenty-five years hence, at which time it may be necessary to devise other corrective measures, which, however, is by no means certain.

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SERVICES OF COMMODORE JOHN RODGERS IN OUR WARS WITH THE BARBARY CORSAIRS (1802-1806).[1]

By CHARLES OSCAR PAULLIN.

FIRST CRUISE IN THE MEDITERRANEAN (1802-1803).

The Barbary corsairs began to capture our merchantmen in 1784, in which year they took the brig *Betsey*. In the following year a second vessel was captured, and later other depredations were committed. Considerable property belonging to our citizens fell into the hands of the corsairs and not a few Americans were enslaved by them. Opinion as to the measures to be taken to prevent these outrages was divided. Some of our statesmen favored the creation of a navy and the use of force, while others thought that the paying of tribute would prove to be the cheapest and best policy. Finally it was decided to try both plans. In 1794 we began to build a navy, and in 1795 we bought a peace with Algiers, agreeing to give her annually maritime stores to the value of $21,600. In the following year we obtained a treaty with Tripoli for nearly $56,000. In 1797, as the cost of treaties had risen, we entered into one with Tunis at an estimated expense of $107,000. In 1797-1798 we built the frigate *Crescent*, loaded her with naval stores, and sent her to the Dey of Algiers as a gift. In 1800 the Dey received another shipload of presents, this time in the *George Washington*, Capt. William Bainbridge, which vessel and captain he impressed into his service, forcing them to carry an Algerine

[1] This article is a part of a biography of Commodore John Rodgers, now in preparation. It is based chiefly upon the "Rodgers Papers," recently deposited in the library of the Navy Department by Rear-Admiral Frederick Rodgers, U. S. N., and upon the official records of the Navy Department. As these documents are arranged chronologically, all quotations from them can be readily verified.

ambassador and a cargo to the Sultan at Constantinople. This indignity offended our national pride and went far towards creating a sentiment favorable to the forcible maintenance of our rights in the Mediterranean.

The Pasha of Tripoli, Yusuf Karamanli, on learning that the rulers of Algiers and Tunis were obtaining more tribute from the United States than himself, became dissatisfied, and demanded a ship of war such as had been given to the Dey of Algiers. Angered at not receiving it, he wrote President Adams a menacing letter. Finally his Royal Highness ordered the flagstaff at the American consulate to be cut down; and thereupon our consul, James L. Cathcart, left the Pasha's dominions, and we were at war with Tripoli. This dramatic declaration of hostilities took place in May, 1801.

Anticipating some such action from Tripoli and fearing that Algiers and Tunis might molest our commerce, the government at Washington early in the spring of 1801 fitted out a squadron of four ships for service in the Mediterranean. Commodore Richard Dale, a seasoned officer who had served under John Paul Jones during the Revolution, was chosen commander-in-chief, and the frigate *President* was designated as his flagship. Dale arrived at Gibraltar on July 1, 1801, and soon proceeded up the Mediterranean. His timely appearance at Algiers and Tunis had a restraining influence upon the rulers of those states, who were becoming dissatisfied and were grumbling over assumed grievances. Several times he showed his vessels off Tripoli; but, since his powers were limited, he did not accomplish much in that quarter. The most notable event of his cruise was the gallant capture of a Tripolitan polacre by the *Enterprise*, Lieut. Andrew Sterrett. Early in 1802 Dale and his ships returned to the United States, and another squadron was sent out.

Dale and his successors in the Mediterranean had many difficult problems to solve, the most important of which related to Tripoli, with which country we were actually at war. The fleet maintained headquarters at Gibraltar, Malta, and Syracuse, none of which ports were convenient to the city of Tripoli, the capital of Tripoli. Gibraltar was distant twelve hundred miles, Malta two hundred and fifty, and Syracuse three hundred and fifty. In the winter, the late fall and the early spring, the heavy northerly gales that prevail on the coast of Tripoli rendered active operations quite

precarious. Even in the favorable season operations against the Tripolitan capital were attended with serious difficulties. The city was situated on a small bay that was cut off from the sea by a barrier of rocks and reefs, which made navigation highly dangerous. Its fortifications were manned by about twenty-five thousand Arabs and Turks, and its forts and batteries mounted one hundred and fifteen guns. Its harbor was protected by a flotilla of gunboats.

In addition to blockading and bombarding Tripoli, our squadron had to pursue and capture the ships of the enemy at sea, and it had to protect American merchantmen by occasionally convoying them from port to port. For a long time the department at Washington sent the commander-in-chief insufficient and improper means for the performance of the work that devolved upon him. Ships arrived in the Mediterranean at uncertain times, and were compelled soon to return owing to the expiration of the term of enlistment of their crews. Communication with the Secretary of the Navy was irregular and infrequent. Moreover, the President took a half-hearted interest in the war, and urged his commanders to bring it to a close, even by purchasing peace if necessary.

In respect to Morocco, Tunis and Algiers the duties of the commander-in-chief were numerous and exacting. The rulers of those states sympathized with the Pasha of Tripoli and secretly aided him. They were always on the point of breaking their treaties with us and had to be continually overawed by a show of force at their capitals. At times their ships had to be watched and their coasts patrolled.

The diplomatic duties of the commander-in-chief in the Mediterranean were quite as important as his naval ones. He was called upon to conduct negotiations for peace, make treaties, and remove and appoint consuls. His correspondence with the American consuls in Barbary was voluminous. The difficulties of his numerous tasks were much increased by the extensiveness of the territory that was covered. The coast of Barbary was more than three thousand miles long. The principal seaport of Morocco, the westernmost state, was Tangier, almost opposite Gibraltar. To the east of Morocco was Algiers, whose capital of the same name was five hundred miles from Tangier. From Algiers to the capital city Tunis was five hundred and fifty miles, and from Tunis to Tripoli three hundred and seventy miles.

Of the four Barbary states, Algiers and Tunis were by far the most powerful. Their navies were stronger than ours. Algiers had fifteen large ships, sixty gunboats, and one hundred and fifty galleys. Tunis had ninety-four large vessels and thirty gunboats. The Moroccan navy contained five vessels, and the Tripolitan eight large ships and a fleet of gunboats. The population of Barbary consisted largely of Moors, Arabs, Berbers, Kabyles, Turks and Jews. The prevailing religion was Mahometan. The customs and dress were oriental. The streets of their cities were narrow, dark, and dirty. The architecture of the public buildings was Moorish. Both people and rulers were semi-civilized, childish, fanatical, superstitious, and lovers of pomp and show.

Commodore Thomas Truxtun was chosen to command the new squadron that was to be sent to the Mediterranean in 1802 to relieve the old one under Dale; but, owing to a disagreement with the department, he resigned from the navy. His place as commander-in-chief was taken by the officer next below him in rank, Commodore Richard V. Morris. The new commander sprang from excellent New York stock. His father, Lewis Morris, was a signer of the Declaration of Independence, and one of his uncles was the distinguished statesman and diplomat, Gouverneur Morris. Richard V. entered the navy in 1798 as captain, and rendered satisfactory service during the French war as commander of the *Adams* and of the *New York*. His squadron in the Mediterranean consisted of the flagship *Chesapeake* 36; *Constellation* 36, Capt. Alexander Murray; *John Adams* 28, Capt. John Rodgers; *New York* 36, Capt. James Barron; *Adams* 28, Capt. H. G. Campbell; and *Enterprise* 12, Lieut. Andrew Sterrett. These vessels sailed from the United States at different times, from February to October, 1802. The *Chesapeake* arrived at Gibraltar with the commodore on board on May 25.

The last ship to sail was Rodgers's vessel, the frigate *John Adams*. She was placed in commission at Washington on August 25, and on the same day Rodgers was ordered to come on from Baltimore and take command of her. The *John Adams* mounted thirty-two guns; twenty-four long 12-pounders on her gun-deck, and two long 9's and six 24-pounder carronades on her forecastle and poop-deck. She was constructed at Charleston, S. C., in 1799. Her two sides were built by different contractors, one of whom reduced her moulds and thereby caused her to have a deficiency of

beam on one side. As a consequence she bore her canvas better and made greater speed on one tack than on the other. Her burden was 544 tons, and her complement 220 men.

Rodgers's sailing orders, which were dated September 18, directed him to proceed from Washington to Hampton Roads; and, after having taken in a supply of beef, pork, rice, beans, butter, gunpowder, and other stores, to sail thence with all possible dispatch to join Morris in the Mediterranean. He left the Roads on October 22, and after a quick voyage arrived at Gibraltar on November 16. Soon putting in to Malaga, he found there Captain Murray of the *Constellation*, who ordered him to return to Gibraltar for a load of supplies. Having performed this errand, he sailed for Malta with the merchant brig *Boston* under convoy. After seeing the merchantman safely to the neighborhood of Minorca, he proceeded to his destination, where he arrived on January 5, 1803.

At Malta Rodgers found the commodore with the *Chesapeake*, *New York*, and *Enterprise*.[1] The *Adams* had been left at the straits to blockade the Tripolitan cruiser *Meshouda* in Gibraltar and to watch Morocco, whose ruler showed signs of unfriendliness. The *Constellation*, which had been expected to join the squadron with a load of supplies, had been ordered home by the department. Morris was now ready to execute certain orders, which he had received from Washington in the previous summer, directing him, with the assistance of ex-Consul Cathcart, to negotiate a treaty of peace with the Pasha of Tripoli. He was to place his squadron off Tripoli, "taking every care [in the words of the Secretary of the Navy] to make the handsomest and most military display of your force and so conducting your maneuvers as to excite an impression that in the event of negotiations failing you intend a close and vigorous blockade." He was directed to hold out "the olive-branch with one hand," while he displayed "the means of defensive operations" with the other. It should be noted that his orders were more concerned with the making of peace than with the waging of war.

Owing to procrastination at Washington, Morris did not receive his instructions in time to carry them out in the summer of 1802. When Rodgers arrived at Malta in the winter of 1803, he was pre-

[1] For the events from January to October, 1803, I have depended chiefly on the Defence of Commodore Morris, Log of *John Adams*, Rodgers' Papers, and Preble Papers.

paring to execute them, notwithstanding that the season of the year was unpropitious. On January 30 he sailed from Malta for Tripoli with the *Chesapeake, New York,* and *John Adams.* The *Enterprise* was not available for this expedition as she was under orders for Tunis. Morris had planned to propose terms of peace to the Pasha, and, in case they should be rejected, to send a flotilla of armed boats into the harbor in the night-time and burn the cruisers of the enemy. He had chosen Rodgers to command the flotilla. Before the little fleet was clear of Malta a heavy gale from the north and west set in. Placing his ships under storm canvas Morris decided to weather it out. At times his flagship labored so heavily as to be in imminent danger of foundering. Finally, after experiencing ten days of the worst kind of weather, he abandoned the expedition and returned to Malta.

The commodore now prepared his ships for a voyage to Gibraltar by way of Tunis and Algiers. This movement was later severely censured by the Secretary of the Navy. In its defense it may be said that not much could be done at Tripoli until spring, the fleet was in need of provisions, the consuls at Tunis and Algiers were urging Morris to pay them a visit, and his orders gave him much discretion as to his operations. Moreover, the department by directing the *Constellation* to return home had caused one of Morris's plans to miscarry, as she had been ordered by him to proceed from Gibraltar to Malta with a load of supplies. Respecting his failure at this time to meet the expectations of the Secretary of the Navy, the commodore afterwards wrote:

> Gentlemen can in their closets plan expeditions at their ease, make winds and seas to suit their purpose, and extend or contract the limits of time and space; but the poor seaman struggling with a tempest on a lee shore must have something to eat.

On February 19 the fleet, together with a capture of the *Enterprise,* the polacre *Paulina,* weighed anchor at Malta and sailed for Tunis, where they arrived three days later. Here an incident took place in which Rodgers, as the officer next in rank to the commodore, played a part. As a portion of the cargo of the *Paulina* was owned by a Tunisian, the Bey of Tunis demanded the restoration of his subject's property, and he entered into a controversy over it with Morris, who, accompanied by Rodgers and Cathcart, went ashore to settle the dispute. At first Morris insisted that the cause of the prize should be tried at Gibraltar, but on the Bey's threaten-

ing war he agreed that the question of the ownership of the cargo might be decided at Tunis. Having obtained one concession, the Bey made a fresh demand. Finally the commodore lost his patience, and abruptly closed the contention. Without taking formal leave of the Bey, he and his aides made arrangements to return to the fleet. While they were on their way to their boat at the wharf, they were overtaken by one of the Bey's agents, who arrested Morris and refused to let him leave the city until he had paid a debt incurred by our consul to Tunis, William Eaton, in behalf of the United States and in prosecution of a plan to set upon the throne of Tripoli the brother of the reigning pasha. This forcible detention was of course a breach of official hospitality and a gross insult to the American flag. In explanation of it, the Bey's agent asserted that Eaton had given his word that the debt should be paid on the arrival of the fleet. Eaton, however, emphatically denied that he had made such a promise. Many palavers over this new subject of contention took place. Finally Morris agreed to pay and the Bey agreed to accept $22,000, about two-thirds of the whole claim; and the commodore was permitted to return to his ship. Cathcart and Rodgers remained a few days longer on shore to complete the settlement of the difficulty. As Eaton was at swords' points with the Bey he also embarked, and Morris appointed Dr. George Davis of the navy to act as consul. This disgraceful episode came to an end on March 10 with the sailing of the squadron for Algiers. Morris always blamed Eaton with enticing him on shore and with the indignity that he suffered, but it must be said that he has not proved his charges against the consul.

On March 19 the fleet arrived at Algiers, and on the next day the American consul, Richard O'Brien, visited the flagship and poured into the commodore's ear a tale of woe respecting the refractory ruler to whose court he was accredited. The Dey had a grievance against President Jefferson, who had sent him $30,000 in money instead of naval stores to that value, which had been expected. The disappointed ruler refused either to accept the money or to permit it to be returned to the donor. He now further exhibited his displeasure by declining to receive Cathcart, who had been appointed to succeed O'Brien as consul. Admonished by his experiences ashore at Tunis, Morris did not leave his ship. After a brief stay he sailed for Gibraltar, where he arrived on March 23.

Here he made several important changes in the fleet. He

shifted his broad pendant to the *New York*, of which vessel Lieut. Isaac Chauncey became acting captain. The *Chesapeake*, Capt. James Barron, was sent home in accordance with orders from the department; and the *Enterprise* was placed under the command of Lieut. Isaac Hull. As soon as the ships had taken on board a supply of provisions they sailed for Malta, the *Adams* proceeding by way of Leghorn with a convoy. On her voyage up the Mediterranean the *New York* had fourteen men killed and five wounded by an explosion of gunpowder. The ship was set on fire and for a time her complete destruction was threatened, but by the heroic exertions of Capt. Isaac Chauncey and Lieut. David Porter she was saved.

When, on May 1, the *New York*, *Enterprise*, and *John Adams* arrived at Malta, only the latter ship was ready for immediate service. On May 3 she received orders to proceed to Tripoli and cruise off that port for three weeks or until the Pasha should make an offer of peace. When Rodgers arrived on his station he boldly approached within three-quarters of a mile of the city and for some time received and returned the fire of the gunboats and batteries. For several days he cruised on his station, seeing only neutral vessels, several of which he chased and boarded. On the 12th, however, he was fortunate enough to fall in with the Tripolitan cruiser *Meshouda*, of 20 guns, which he captured. For two years she had been blockaded at Gibraltar by our cruisers. Desirous of assisting the Pasha, the Emperor of Morocco laid claim to her, and Morris foolishly allowed his claim. Having thus acquired her liberty, the *Meshouda* obtained a load of naval and military stores, and was entering Tripoli when Rodgers captured her. She had on board twenty Tripolitan subjects. Rodgers took his prize to Malta where he arrived on May 19.

Since the *New York* and *Enterprise* were now ready for sea, the *John Adams* sailed in company with them on her return voyage to Tripoli. Commodore Morris was in command of the fleet. On the 22d, when he was approaching Tripoli, he discovered several small merchantmen, and he signaled his ships to chase them, which they at once did. Almost immediately several of the enemy's gunboats, which were stationed in the harbor, got under way and came to the rescue of their countrymen. For some time both sides kept up a brisk fire, but in the end the merchantmen escaped to Old Tripoli, a short distance from the main city, and the

gunboats returned to the harbor. During the following night the enemy hauled the merchantmen on shore, and to protect them built some breastworks of stone and bags of wheat. On the next day the commodore sent the boats of the squadron under the command of Lieut. David Porter to destroy the vessels. Facing a hot fire, Porter and his men went ashore, drove the enemy from his breastworks, set fire to his vessels, and regained their boats. Unfortunately the enemy, disregarding the broadsides discharged by the American ships, succeeded in extinguishing the flames before they had done much damage. Porter lost several men and was himself wounded.

Morris's plan was first to frighten the Pasha by attacking his gunboats, and then to offer him the olive-branch of peace. On May 26 the fleet was re-enforced by the *Adams*. On the following day the *New York*, *John Adams*, and *Adams* approached the city, and the gunboats came out to meet them. Rodgers, who was placed in the lead with the *John Adams*, bore up, and gaining a position near the enemy, opened fire upon him. Unfortunately the *New York* and *Adams* fell in directly behind Rodgers, and were unable to fire for fear of hitting his vessel. The *John Adams* continued the engagement until the gunboats retired to their station in the harbor where they were protected by the land batteries. She suffered no losses; the gunboats had several men killed and wounded. On being censured for his disposition of the *New York* and *Adams*, Morris defended himself on the ground that his faulty maneuvering resulted from causes beyond his control.

On May 29, the commodore, through Nicholas C. Nissen, the Danish consul, opened negotiations with the Pasha for a treaty of peace, and a few days later he sent Rodgers ashore to arrange the preliminaries. On June 7 the commodore disembarked, and on the following day he held an interview with the Pasha's trusty minister, Mahamed Dghies. The Pasha boldly declared that he did not fear war, that it was his trade, and that he understood it "better than anybody." However, he said, if the United States wished peace, they might have it for two hundred thousand Spanish dollars and the expenses of the war. Morris offered him fifteen thousand dollars—five thousand dollars as a consular present, and ten thousand dollars at the end of five years if the treaty should be faithfully kept. The Pasha's reply was an order for the commodore to depart at once, which he did. Morris had faithfully exe-

cuted the commands of Jefferson, but he had failed to obtain the treaty of peace which the President so much desired.

On May 10 the commodore sailed for Malta leaving Rodgers in command of the blockading squadron. After cruising several days off Tripoli without seeing any of the enemy's vessels, the monotony of Rodgers's duties was broken by a stirring adventure, which he has described in a letter to the Secretary of the Navy, dated December 4, 1803:

On the evening of the 21st of June, last, owing to some extraordinary movements of the gunboats in the harbor of Tripoli, I was induced to conceive that the Pasha either intended to send some cruisers to sea during the night, or that he had received intelligence of some bound in. I therefore accordingly made such disposition of the vessels engaged in the blockade as to enable us to intercept either, by stationing the *Adams*, Captain Campbell, to the westward; the schooner *Enterprise*, Lieutenant Hull, to the eastward; and remaining myself, with the *John Adams*, abreast of the town. At half-past 7 a. m. on the following day, *Tripoli*, bearing W.S.W., distant three or four leagues, observed the *Enterprise* in the S.S.E. with a signal flying, its signification not distinguishable; made sail and stood towards her; at 8 a. m. spoke the *Enterprise*, when Lieutenant Hull informed me that a large ship of the enemy was anchored close in with the beach.

At half-past 8 a. m. shortened sail and prepared to anchor with springs on our cables, discovering that the enemy was anchored with springs on his cables in a deep narrow bay about five or six leagues to the eastward of the town and in a situation very advantageous to the defence of their ship. At the same time observed nine gunboats close in with the shore coming to her assistance, and a vast number of cavalry and armed men on the beach. At seven minutes before 9 a. m., being in seven fathoms' water and supposing we were within point-blank shot, commenced firing, which the enemy returned; and a constant fire was maintained on both sides for forty-five minutes, when the enemy's fire was silenced, at which instant the crew abandoned the ship in the most confused and precipitate manner, such as her boats could not carry leaping overboard. At this moment, being in a quarter less than five fathoms' water and the rocks appearing under our bottom and in every direction around us, I thought it prudent to wear and lay the ship's head off shore; and in the meantime ordered Lieutenant Hull to stand as close in as consisted with safety and amuse the enemy on the beach until our boats could be hoisted out to take possession.

At a quarter before 10 a. m., discovering one of the enemy's boats returning to the ship whilst in the act of hoisting out ours, tacked and renewed our fire, and in a few minutes after had the satisfaction to see the enemy's colors hauled down, at the same time firing both their broadsides, which were accompanied by the ship's blowing up with a tremendous explosion, which burst the hull to pieces and forced the main and mizzen

masts one hundred and fifty or one hundred and sixty feet perpendicularly into the air, with all the yards, shrouds, stays, etc., belonging to them.

This ship was polacre rigged, mounting 22 guns, and the largest cruiser belonging to Tripoli, to appearance a very fine vessel; and from the number of persons we saw abandon her, her crew must have consisted of upwards of two hundred men. All the men who returned to the ship were blown up in her, and I have reason to believe her captain among the number, as well as many lives lost before they abandoned her, as we saw several shot-holes through her. Immediately after the ship blew up, I ordered the signal made to chase the gunboats, but was not able to approach them within gunshot, owing to the water being very shoal a great distance seaward of them.[8]

Soon after this event Rodgers received orders to raise the blockade and proceed to Malta, which he did, arriving in port on June 28. Commodore Morris had now decided to abandon his operations against Tripoli and to return to Gibraltar with his fleet by way of Messina, Naples and Leghorn. To say the least, this movement was injudicious. Morris defended it on the ground that his heavy ships could accomplish nothing more at Tripoli, that there was a possibility of obtaining some light-draft vessels at Messina or Naples, that the fleet was needed in the straits to oppose Morocco, that it was dangerous to separate his ships, and that the *Adams* must be sent home. The commodore was evidently confused by a multiplicity of objects. He was basing his actions too much upon probabilities. The war with Tripoli was an actuality, and his ships could have continued the blockade with advantage.

On July 11 the whole fleet, together with the prize *Meshouda*, sailed for Messina, where it arrived three days later. Here Morris tried to obtain the loan of some gunboats, and was referred to Sir John Acton, the chief minister of the King of the Two Sicilies, residing at Naples, to which port the fleet next proceeded. Sir John conditionally promised Morris ten gunboats and two bomb ketches for use against Tripoli in the following spring. The fleet left Naples on August 3 and ten days later arrived at Leghorn, where the ships were separated. The *Enterprise* was sent to Malta for dispatches, the *Adams* to Tunis with Consul Cathcart, and the *John Adams* to Gibraltar with a convoy.

Rodgers left Leghorn with five merchantmen under his protection on August 24, and, after calling at Barcelona and Alicant,

[8] Goldsborough, Naval Chronicle, 208-209.

arrived at Malaga on September 11. Here he found the commodore, who had recently come from Leghorn with the *New York*, and also Lieut. Richard Somers in the schooner *Nautilus*, lately from America. Somers brought dispatches from the government, which contained the surprising intelligence that Morris was suspended from his command and Rodgers was appointed to succeed him. "We have been for some time much disappointed with the conduct of Captain Morris," Secretary Smith wrote to the new commander-in-chief. "He has not done anything which he ought to have done, and despairing of his doing anything and also as a mark of our disapprobation, it has been determined to suspend him. We, besides, can obtain from him no information what he is proposing to do. We have generally to rely upon others with respect to his movements."[1]

On September 14 Rodgers and Morris anchored at Gibraltar, where they found Commodore Edward Preble, who had recently come from America with a new squadron, bringing orders for all the vessels of the old squadron, with the exception of the *Enterprise*, to return home. Morris sailed for Washington with the *Adams* on September 25. Rodgers would have soon followed him with the *New York* and *John Adams* had not a cause arisen for delaying his departure.

For some time the Emperor of Morocco had been menacing our commerce, and recently his cruisers had begun to prey upon it. In August one of his ships, the *Mirboka* 22, after capturing an American brig, was taken by the frigate *Philadelphia*, Capt. William Bainbridge. Under these circumstances Rodgers made preparations to communicate with the Emperor and ascertain whether he preferred peace or war. Preble also had determined to bring the Emperor to terms. After a consultation the two commodores decided to combine their efforts, and Rodgers, although the senior officer and somewhat hurt at the sight of the broad pennant of his junior flying in the same harbor with his own, agreed to give Preble the precedence. On September 17 the commodores visited Tangier with a view to entering into communication with the Emperor. Pending his arrival there, some six or seven of our vessels blockaded the principal ports of Morocco. Rodgers made an extensive cruise on the west coast, and Preble returned to Gibraltar.

Early in October, anticipating the coming of the Emperor, the

[1] Rodgers' Papers, Smith to Rodgers, June 21, 1803.

commodores returned to Tangier and moored their fleet in battle array, three hundred yards from the shore. The decks were cleared for action, and the crews slept at their quarters. The Emperor arrived on October 6. Although he had an army of twenty thousand men in the town and his shore batteries mounted one hundred and five cannon, he was disposed to seek peace, being cowed by the sight of the American ships drawn up under his guns. As a token of his friendly mood, he sent the commodores a present of cattle, sheep and fowl. He readily agreed to give up the prisoners and property that had been captured by his ships, and to reaffirm the treaty of 1786 which his father had made with the United States. On their part the commodores agreed to surrender the *Meshouda* and *Mirboka*. Within less than a month, by a proper show of force, Preble and Rodgers had obtained an honorable treaty with Morocco without the payment of a cent for tribute or presents. James Simpson, the American consul at Tangier, and Tobias Lear, who had been recently appointed consul-general to Algiers, assisted them in the negotiations.

As soon as our affairs with Morocco were settled, Rodgers prepared the *New York*, which was now his flagship, and the *John Adams*, Capt. H. G. Campbell, for their return voyage. He sailed from Gibraltar on October 18 and arrived at Washington on December 2, 1803. The news of the peace with the Emperor which he brought was highly pleasing to President Jefferson who, on December 5, informed Congress in a message of the amicable adjustment of all our differences with Morocco. He said that the conduct of our officers "merited entire approbation," and he referred to the "promptitude and energy" of Commodore Preble and to the "efficacious co-operation" of Captains Rodgers and Campbell. He also called attention to the "gallant enterprise of Captain Rodgers in destroying on the coast of Tripoli a corvette of that power of 22 guns"; and he recommended that Congress indemnify the captors of the *Meshouda* and *Mirboka*. Accordingly a law was passed appropriating to the captors a sum of money equal to one-half the value of the two vessels.

Rodgers had been absent from the United States more than thirteen months—from October, 1802 to December, 1803. He had distinguished himself in the two principal achievements of that period in the Mediterranean, the blockading of Tripoli and the establishment of peace with Morocco, although on both theaters of

action he was second in authority. In conducting the blockade he played a more important part than did his senior, Commodore Morris, and in bringing the Emperor of Morocco to terms he shared the honors with Commodore Preble. In succeeding Morris as commander-in-chief, he for the first time obtained the command of a squadron and received the title of commodore, an honor that came to him at the age of thirty. During his absence from the United States Rodgers gained three numbers on the captains' list by reason of the retirement of McNeill and the resignation of Dale late in 1802, and the death of Barry, the senior officer of the navy, in September, 1803. Barry's successor as senior officer was Commodore Samuel Nicholson.

When Commodore Morris arrived in the United States in the fall of 1803 he was haled before a court of inquiry, composed of two junior captains and a lieutenant. It reported that the commodore had not conducted himself in his command of the Mediterranean squadron "with the diligence or activity necessary to execute the important duties of his station." The next regular step in naval procedure would have been the convening of a court martial to try him. Jefferson, however, in May, 1804, arbitrarily dismissed Morris from the navy, without a trial. His punishment greatly exceeded his offense. By the dismissal of Morris, Rodgers gained another number on the captains' list. Only three officers, Commodores Nicholson, Murray and Samuel Barron, were above him in rank.

THE SECOND CRUISE IN THE MEDITERRANEAN (1804-1805).

Commodore Preble sailed from Gibraltar for Malta soon after Rodgers left the Mediterranean station in October, 1803. In September he had sent the *Philadelphia*, Capt. William Bainbridge, and the *Vixen*, Lieut. John Smith, up the Mediterranean to blockade Tripoli. On October 31, while pursuing a Tripolitan cruiser, Bainbridge ran the *Philadelphia* onto some hidden rocks, four or five miles to the eastward of the Pasha's capital. He made strenuous efforts to float his vessel, but without success, and he was compelled to surrender her to the enemy. Aided by a heavy northwest wind that raised the level of the water, her captors soon floated their prize and brought her into port. Three hundred and seven American officers and seamen were thus made prisoners. The officers were for the most part not badly treated. At first the

crew were closely confined; but later they were set to hard work, and were often stoned and flogged through the streets of Tripoli like beasts of burden. The possession of these Americans by the Pasha, who on occasion threatened to kill them if the commander-in-chief of our squadron did not respect his wishes, greatly strengthened his position.

Commodore Preble arrived at Malta on November 27, 1803. During the ensuing winter and spring he was engaged in maintaining the blockade, in watching the discontented rulers of Tunis and Algiers, and in preparing to attack Tripoli. The most notable event of the winter was the burning of the *Philadelphia*, in the night-time, in the harbor of Tripoli, by the ketch *Intrepid*, Lieut. Stephen Decatur. For this gallant exploit the young lieutenant received a captaincy from the President and a sword from Congress. By the latter part of July, Preble was ready to begin the reduction of the capital. His fleet consisted of his flagship *Constitution*, six small brigs and schooners, and six gunboats and two bomb ketches which he had borrowed of the King of the Two Sicilies. Several times in August and the early part of September he attacked the enemy's gunboats and land defenses, and inflicted much damage upon them. In these operations he had fifty men killed and wounded; the loss of the Pasha was doubtless greater. Among the American officers who were killed were Capt. Richard Somers, Lieut. Henry Wadsworth (an uncle of the poet Longfellow), James Decatur, James R. Caldwell, and Joseph Israel—the first commissioned officers of the navy under the Constitution to die for their country. The Pasha offered to make peace for $100,000, but the commodore spurned his offer. While in the midst of these promising operations, Preble was succeeded by a new commander-in-chief, who arrived before Tripoli on September 10, 1804. In December Preble sailed for America, taking with him the congratulations of his officers and friends on his brilliant service.

The capture of the *Philadelphia* and the imprisonment of her officers and crew thoroughly aroused the President, who now for the first time manifested a lively interest in the prosecution of the war. He decided to increase considerably the naval forces in the Mediterranean. Early in April five frigates, which had been laid up in ordinary in the Eastern Branch of the Potomac at Washington, were placed in commission. These vessels were the *President*

44, the flagship of the new squadron, Commodore Samuel Barron; *Congress* 36, Capt. John Rodgers; *Essex* 32, Capt. James Barron; *Constellation* 36, Capt. H. G. Campbell; and the *John Adams* 28, Acting-Capt. Isaac Chauncey. The new commander-in-chief, Commodore Samuel Barron, was a member of the distinguished Virginian naval family of Barrons. When a mere youth he served in the Revolutionary War under his father, James Barron Sr., the commodore of the Virginia navy. In 1798 he entered the Federal navy as captain, and in the conflict with France commanded successively the *Richmond*, the *Constellation*, and the *Chesapeake*.

Rodgers's call to sea duty found him in Washington where he had been employed since January, 1804, in superintending the construction of a gunboat—the very first vessel of Jefferson's famous flotilla. In July of that year *Gunboat No. 1*, being completed and ready for sea, sailed for Charleston, S. C., where, soon after her arrival, her seagoing career was interrupted by a severe storm which drove her from her moorings and left her high and dry in a cornfield. During the spring, anticipating his return to the Mediterranean, Rodgers extended his knowledge of the classic lands of antiquity by reading Virgil, Herculaneum, and doubtless similar works. He also found time to procure a midshipman's warrant for his youngest brother, George Washington Rodgers, now a lad of seventeen years. Nor was he too busy to participate in the social diversions of the rural capital, attending on one occasion a ball that was given by his friend, Capt. Thomas Tingey, and other leaders of the polite society at the seat of government.

His new command, the frigate *Congress*, was about the size of the *Insurgente*. She was built at Portsmouth, N. H., during the French war, costing some two hundred thousand dollars. Her burden was 1268 tons, and her complement 340 men. During April and May, 1804, Rodgers was equipping her in Washington, and about the first of June he dropped down to Hampton Roads. He was pleased with neither the crew nor the equipment of his vessel, both of which had been hastily supplied. At the Roads he discharged several men—"miserable, useless, unsound wretches," he called them, "perfectly unqualified for any service." He had his gunner, "an infamous scoundrel," court-martialed. To a responsible employee of the Washington yard who had failed to equip the *Congress* with certain necessary articles, after having promised faithfully to do so, the irate captain wrote: "It is your

interest to pray that my head may be knocked off before I return, for be assured if you are not punished before that period I will revenge the injury you have done me with my own hands."

The *John Adams* sailed from Hampton Roads on June 26; and the four remaining vessels, under the immediate command of Commodore Barron, on July 5. For the first two weeks of Barron's passage the weather was favorable, but for the last twenty-five days the winds were ahead and the sailing very tedious. To facilitate the movement of the fleet, the commodore on August 7 ordered each captain to make his way to Gibraltar as best he could, independent of the other ships. Rodgers, who reached Gibraltar on August 12, was the first to arrive in port. Later on the same day the *President* and *Constellation* came in, and on the following day the *Essex*. Suspecting that the Emperor of Morocco was contemplating hostilities, Barron ordered Rodgers to take the *Congress* and *Essex* and ascertain the intentions of that fickle ruler. The commodore with the other two vessels proceeded up the Mediterranean, and on September 10 arrived off Tripoli and relieved Preble as commander of the blockading squadron.

On August 15, Rodgers sailed from Gibraltar to Tangier with the *Congress* and *Essex*. After communicating with the American consul, he ordered the *Essex*, Capt. James Barron, to watch the movements of two of the Emperor's galleys then in Tangier bay, while he proceeded in the *Congress* down the west coast on a cruise of observation. He visited the western ports of Morocco as far south as Salle, but discovered no signs of hostility. As the Emperor appeared to be in a friendly mood, Rodgers returned to Gibraltar. He deemed it prudent, however, to order the *Essex* to remain in the straits and guard our interests in that quarter. With the *Congress* he proceeded up the Mediterranean to join Commodore Barron, being anxious (as he said) that his vessel should share the credit to be derived from the reduction of Tripoli by inscribing a lasting and honorable remembrance of her name on its walls. Calling at Algiers, he received on board the *Congress* his friend, Col. Tobias Lear, who was now consul-general to Algiers and was charged by his government with conducting negotiations for peace with the Pasha of Tripoli. After landing Lear at Malta Rodgers joined the blockading squadron.

Soon after Commodore Barron arrived off Tripoli he was attacked by an extreme illness, caused by a disease of the liver.

Hoping to improve his health, he now gave Rodgers the command of the blockading squadron and returned to Malta. Rodgers remained on the coast a little more than a month, during which time he was engaged in active cruising. The only vessels of the enemy that he saw were four small coasting boats, which effected their escape by reason of light winds and hazy weather. He wrote:

> Two of these boats I chased on shore, one about three and the other five miles to the westward of the town; and sent three boats in to bring one of them off, anchoring at the same time within the reach of grape of the shore, conceiving I should be able to cover the boats so effectually as to enable them to execute my orders without much opposition. But being so near the town and in sight of an Arabian camp, before they could reach the shore the enemy collected in such numbers as to make the thing impracticable without the greatest probability of making sacrifices or at least hazarding more than the emergency of such an acquisition would justify. The enemy were covered by the rocks in a manner to prevent my annoying them much by the fire from the ship. To the officers (Lieutenants Wyer, Henley, and Blakely, commanding the boats) and men engaged in this service, it is but justice in me to observe that they would have affected the execution of my orders, I have not the least doubt, in spite of all opposition, had I not been induced, through motives of regard of the consequences of hazarding the lives of so many brave men to affect an object of so little importance to their country, to countermand my orders by signal after they had reached the enemy within pistol shot.

This incident is characteristic of Rodgers's great care and regard for his men. Throughout his naval career he showed an unwillingness to hazard their lives unless the chances or results of success warranted the risk. On the other hand he was remarkably reckless of his own life when there existed the merest possibility of attaining a worthy object. Several incidents exhibiting his fearlessness and personal daring have already been narrated—the facing of a mob in Liverpool, the cowing of the mutinous crew of the *Insurgente*, and the saving of life and property at Cape Francois. An incident of a somewhat similar character occurred on the blockade, and may be told in Rodgers's words:

> Conceiving it an object of no small importance to know to certainty to what distance our ships can approach the batteries of Tripoli with safety, I had resolved for some time past on sounding, the first favorable opportunity, for this purpose. And on Friday night, 19th instant, I made the attempt and succeeded without interruption, much to my satisfaction. It being between one and two o'clock in the morning when I went in, and everything quiet, I was enabled to approach so near as to observe the position of the cruisers, and found that all the gunboats were hauled up

with their sterns foremost on the beach so as to enable them to act as a battery, and the ketch, schooner, brig, and two galleys dismantled and moored to the walls. The brig has no masts in. I am now sufficiently acquainted with the coast contiguous to the batteries to consider myself a good pilot. And this has proved to me, in service like this, the necessity of every man-of-war having a gig, as the sounding of an enemy's coast can be effected in one of these boats without risk, when it cannot be done in any other way with safety. I was in four feet of water, unperceived, although I could hear the people on shore distinctly in common conversation.

Towards the latter part of October, Rodgers sailed for Malta to obtain water and to repair his ship. On his way to port he captured a small xebec, mounting two carriage guns and some howitzers, and carrying nine Turks. She had neither colors nor a scrap of paper of any kind showing her nationality. Her crew said that she was a prize to a Tunisian cruiser, but Rodgers was inclined to believe that she was a Tripolitan vessel and that her papers had been destroyed to conceal her identity. He therefore took her into Malta for examination.

On November 1 Commodore Preble delivered to Rodgers by order of Commodore Barron the frigate *Constitution*, and a few days later the flag of her new commander was hoisted on board her. She was Rodgers's first 44, and for several years was his sea-home. This famous frigate was built at Boston in 1794-1797, after models furnished by Jonathan Humphreys, the skilful architect of our early naval ships. He is said to have drawn many of his ideas of shipbuilding from the French practice. The distinguishing feature of his vessels was their excess in size and armament over vessels of the same class in foreign navies. The lines of the *Constitution* were remarkably fine, and her beauty elicited the admiration of all observers. She mounted twenty-eight long 24's on the gun-deck, and six 24's and ten 12's on her upper deck. Her length on the load water-line was 175 feet and her breadth of beam 43.6 feet. Her draft was 22 feet. Her tonnage was 1576. Her tanks held 48,600 gallons of water, and her hold stowed six months' provisions. She carried 22 commissioned and warrant officers and 378 petty officers, seamen, and marines—400 men in all. Sailing free under topgallant-sails, her speed was 13.5 knots.

From Malta, Rodgers proceeded to Syracuse, where our fleet had a depot of supplies and a naval hospital. Here he found Commodore Barron, who was still sick. "I am so unwell to-day," Barron said on November 3, "that I can scarcely write at all and am

unfit for business. God knows how it will end!" Ten days later he made Rodgers acting commander-in-chief of the squadron, writing to him as follows: "As I shall not be able to attend to the business afloat for some time, I request you will hoist the broad pendant on board the *Constitution* and give such orders for the safety of the squadron from time to time as may be most proper." By the latter part of the month Barron's health had improved, and since not much could be done on the blockade during the winter he decided to send Rodgers to Lisbon for seamen, where it was understood they were plentiful. Rodgers was to call at Tangier on his way through the straits, and, in case he found the Emperor peacefully disposed towards us, he was to order the *Siren*, which was now guarding our interests in that quarter, to join the commodore.

Rodgers left Syracuse on November 29 and arrived at Gibraltar on December 18. Owing to an epidemic of yellow fever, he did not go ashore, but proceeded at once to Tangier, where he was pleased to learn that our relations with the Emperor were quite satisfactory. On the way to Lisbon he encountered a heavy westerly gale which drove him off his course, and for a time compelled him to carry a heavy press of sail to avoid being cast away on the coast of Morocco. On December 28 he reached Lisbon, with his bowsprit badly strained and his sails much damaged. Here he was delayed several weeks under circumstances that greatly tried his temper. Several days elapsed before he could obtain practique, and on reaching the city serious difficulties arose over the enlistment of seamen. For many of the inconveniences that he suffered, Rodgers blamed the American consul, William Jarvis, with whom he had a serious altercation. He threatened the consul with chastisement; and accused him of neglecting the interests of his government, of interference with the enlistment of seamen, and of "contemptible ungentlemanly conduct."

After enlisting all the recruits that could be obtained at Lisbon, Rodgers sailed for Gibraltar, where he arrived on February 14, 1805. Since some recent movements of the Emperor's cruisers looked suspicious, he ordered the commander of the *Siren* to remain in the straits. His stay in port was very brief, as he was exceedingly desirous to regain his commodore. "I can scarcely describe the anxiety which I feel for the approach of summer," he wrote at this time to the Secretary of the Navy, "as I am satis-

fied that if we do our duty we shall reduce Tripoli in a manner that will be particularly advantageous and highly honorable to our country." The *Constitution* arrived at Malta on February 25.

Since the spring of 1805 constitutes an important period of the Tripolitan war, it may be well to obtain a general view of the distribution of the ships of the squadron at that time. Barron's fleet in commission consisted of five frigates and seven small sailing craft. The *Siren* (Stewart) was stationed in the straits. The eleven remaining vessels were engaged chiefly in three enterprises, the most important of which was the blockading of the capital and coast of Tripoli. Four vessels were wholly employed on this duty: the frigates *Constitution* (Rodgers), *President* (Cox), and *Constellation* (Campbell), and the schooner *Vixen* (Smith). During the early spring three other ships were also thus employed: the frigates *Congress* (Decatur) and *Essex* (J. Barron), and the schooner *Nautilus* (Dent). A second enterprise was the obtaining of naval materials of various kinds from Italian and Austrian ports, which work fell to the *Essex* and *Congress*, and the schooner *Enterprise* (Robinson). The schooners *Argus* (Hull) and *Nautilus* (Dent), and the sloop *Hornet* (Evans), found employment in a third undertaking. This requires some explanation.

As a passenger on board the *President* with Commodore Barron, there returned to the Mediterranean in the summer of 1804 William Eaton, formerly a captain in the United States army, later consul to Tunis, and now navy agent to the Barbary regencies. This erratic genius was authorized by Jefferson to undertake an expedition designed to place upon the throne of Tripoli Hamet Karamanli, an older brother of the reigning Pasha, and by descent the rightful ruler of the nation. Hamet, it was said, was willing to make a most favorable treaty of peace with us, and his friends and allies would aid us in reducing the Pasha's capital. The first step in this ambitious undertaking was to find Hamet, who had sought refuge in Egypt. In November, 1804, Eaton was conveyed to Alexandria by Lieut. Isaac Hull in the *Argus*. He finally found the refugee some hundreds of miles up the Nile among the Mamelukes, and returned with him to the coast. Forty miles to the westward of Alexandria Eaton collected an "army," consisting of about four hundred men, one hundred and five camels, a few asses, and a quantity of military stores. It contained ten Americans: General William Eaton, commander-in-chief; Lieut. P. N. O'Ban-

non, of the marine corps; Midshipman P. P. Peck, a non-commissioned officer; and six marines. In Eaton's motley troop there were twenty-five cannoneers of various nationalities, with three officers; thirty-eight Greeks, with two officers; Hamet and his suite of about ninety men; a party of Arabian cavalry; and several footmen and camel-drivers.

On March 8, 1805, the army began its march across the Libyan desert to the port of Derne, distant some six hundred miles. This town, the second largest in Tripoli, was the capital of an extensive province. All the genius, resource, and valor of the general were needed to bring to a successful conclusion his daring venture. After encountering many obstacles and undergoing great privations and dangers, he brought his army, now re-enforced by a rabble of Arabs, before Derne, which place, with the aid of the *Argus, Nautilus,* and *Hornet,* he captured on April 27. Here for several days his position was exceedingly precarious. He succeeded, however, in defeating the forces of the Pasha that were sent against him, and in strengthening his army; and he felt confident that by the aid of the fleet he could continue his march westward to the capital, some seven hundred miles distant, and capture it. His plans, however, seem chimerical in view of the long march across the desert, the exhaustion of his resources, the timidity and irresolution of Hamet, and the poverty and small number of the exiled Pasha's followers. It is not clear how the general could do more than hold Derne.

Rodgers had nothing whatever to do with Eaton's daring exploit. He spent almost the whole of the spring of 1805 before Tripoli in command of the blockading squadron. Once, in March, he made a brief visit to Malta to see the commodore, who was still sick. When the weather was fine he frequently reconnoitered the harbor in quest of information respecting the enemy's forces. On April 24, some five miles from Tripoli, he fell in with and captured a privateer of eight guns, accompanied with two Neapolitan prizes, and bound directly into port. The captured vessels were sent to Malta in charge of the *President,* Capt. George Cox.

Several times during the spring Rodgers communicated with Bainbridge, sending him letters and clothing for himself and men. Since all correspondence was censored by the Tripolitan officials, Rodgers was unable to write as freely as he wished, but he suc-

ceeded in hinting to the unfortunate captain that the prospects of his release were bright. He wrote:

> Chance has placed you in a situation which requires patience and fortitude to withstand. Fortitude I know you possess, and patience you must summon to her aid a little longer. The officers of every denomination in the squadron participate in your sufferings; every nerve will be exerted in your behalf, and every face will beam with pleasure the day that fate shall decree you and your fellow-sufferers free men. Patience! Pray make my regards to Messrs. Porter and Renshaw, and be pleased to inform Mr. Renshaw that his friends in Philadelphia are well, as also those of Mr. Gibbon in Washington and Virginia. I have sent two trunks containing wearing apparel, one for Dr. Ridgely and Mr. Harwood, and the other for Mr. Gibbon, which were sent out from Washington in the *Congress*.

As Commodore Barron remained sick at Malta throughout the spring, his arrangements for the blockade and the proposed attack on Tripoli were not made with the energy or vigor that he otherwise would have shown. In March, Rodgers outlined a plan for conducting the blockade, intercepting the enemy's cruisers, and providing an auxiliary force for offensive operations, which he sent to Barron. "I would not have ventured to have given an opinion unasked for, thus freely," he wrote, "was it not with an intention of alleviating the anxiety which you must naturally feel in consequence of your being debarred from using those exertions which your capacity would enforce were you in health." Rodgers believed that the attack on Tripoli should be made before the first of June. April went by and then the first part of May, without a sign from the commodore that he planned to make an immediate movement. These were anxious days for Rodgers. On April 17 he forcibly expressed his views in a letter to Lear:

> I do not believe that he [the pasha] will accede to what you will consider equal terms, until he is made more sensible of our force and demonstratively convinced of our capacity to use it. . . . . I feel more than ever confident our present force, with an addition of two mortars and two gunboats, will enable us to give you the opportunity of negotiating a peace perfectly to your wishes. If the attack is made within six weeks, under proper regulations, I will pledge all that's sacred and dear to me that we succeed in the most perfect, handsome, and honorable manner.

At this time Commodore Barron and Colonel Lear agreed with Rodgers that Tripoli should be attacked before negotiations for peace were begun, a view that was in accordance with a sound military judgment. A more favorable treaty could certainly be negotiated after the Pasha had seen the American squadron drawn

up in battle array before his capital and had felt the full force of the argument that its guns were capable of making. Moreover, the American government expected Barron to reduce Tripoli, and was preparing to send him a fleet of gunboats. Since the fall of 1804 he had been waiting for the coming of spring when favorable weather would permit offensive operations.

On one of the last days of April one of the vessels of the squadron arrived at Malta, bringing direct overtures for peace from the Pasha. The choice of refusing or accepting them lay with Commodore Barron. Lear's orders were to negotiate a treaty of peace when, in the opinion of the commander-in-chief, the time for making peace had arrived. Barron wisely declined to accept the overtures. His views on May 1 may be obtained from a letter that he wrote to Rodgers on that date: "My health, I am happy to say, has greatly improved within a few days. My strength begins to return and I have sanguine hopes that I shall be able to appear personally before Tripoli as soon as the season is sufficiently advanced for entering upon offensive operations." It is thus seen that on May 1 the commodore intended to attack Tripoli. The outlook for the success of the American arms was highly favorable—even more favorable than Barron at the time had reason to expect, for he did not then know that Eaton was in possession of Derne and that the government at Washington was sending out re-enforcements.

The following sentences extracted from a letter of Lear to Rodgers show the peace commissioner's views on May 1:

> I have received by the ketch a letter from the Spanish consul written by the express desire of the Pasha, saying that he proposed as the ground work of a negotiation that we should pay him two hundred thousand dollars for peace and ransom and give up all his subjects in our hands gratis with all their property. This is the first direct overture which has been officially made, and although much less extravagant than I should have expected, yet is totally inadmissible. . . . . The ground work, however, must be very different from this before I can think of raising a superstruction. . . . . I see no prospect of all our force being concentrated and ready to act against Tripoli before the beginning or middle of June, so that I must regret that you will not have your just and sanguine wishes accomplished of seeing us ready to make an attack before that time.

A few days after May 1 Commodore Barron's plans underwent a complete change. By May 18 he had decided to relinquish the command of the squadron to Rodgers, to abandon the attack on

Tripoli, and to accept the Pasha's overtures for peace which he had recently rejected. Why the commodore had suddenly reached conclusions so widely different from his former ones is an interesting question. In the first place, the expected improvement of his health had not been effected, and he was therefore constrained to surrender the command of the squadron to Rodgers. His interest in offensive operations, since they were not to be directed by himself, naturally declined. The reasons for the abandonment of his plans that he gave doubtless had much weight with him; his application to the Neapolitan and Venetian governments for the loan of some bombards and gunboats had resulted in disappointment and failure, and such craft were "essential to ensure the complete success of offensive operations"; several vessels must be sent home because the term of enlistment of their crews would soon expire; the weakness of Hamet and his cause did not warrant further co-operation with him; the capture of Derne would lead the Pasha to moderate his pretensions and to accept a peace honorable to the United States; and no opportunity to release Bainbridge and his men that promised success should be lost.

The commodore was probably assisted in arriving at his conclusions by his brother, Captain James Barron, who reached Malta from Venice and Trieste on May 12. Since October, 1804, the captain had greatly aided the commodore in managing the fleet. Rodgers believed that the younger Barron was his enemy, and was intriguing against him. He said that Captain James used "every means which his imagination could invent to induce the commodore not to give up the command," while at the same time he was "assuring me with the gravity of a Judas that he had been endeavoring to prevail on his brother to resign."[1] Lear was accused of exerting an undue influence over the commodore in behalf of peace, but Rodgers emphatically denied the charges made against his friend. It must be said, however, that Lear was not a bellicose man. The choice of peace or war lay with the elder Barron, and he must be held responsible for his official acts. It is true that his health was bad; but his mind, if we may judge from his letters, was clear and sound. Certainly Rodgers had no part in determining the commodore's decision. He was on the blockade before Tripoli, and was daily expecting the arrival of the whole squadron prepared for offensive operations. He declared afterwards

[1] Rodgers' Papers, Rodgers to Eaton (undated).

that he was always positively of the opinion that a negotiation ought never to have been attempted until "our whole force was drawn up before the enemy's walls."[6] The commodore's action was precipitate. The sudden withdrawal of his support from General Eaton, with whom he had been co-operating for several months, placed his ally in a most embarrassing position. Nor was it just to Rodgers that the commodore should adopt a wholly new policy at the very moment of his resignation and bind his successor to carry it out. On the other hand, it should be said that had Barron been a well man he would certainly have attacked Tripoli; and that his decision to make peace was not without beneficial results to the United States.

The commodore's letter resigning his command and notifying Rodgers of his determination to begin negotiations for a treaty was dated Malta, May 22, 1805. After referring to his ill health, he said:

> To relinquish my command, therefore, is, I conceive, a duty which I owe to our country and to the service in general, but more particularly to the present squadron—an act of justice which the skill, courage, and general merits of the officers and the order and discipline of the crews at once enforce and embitter. For you, sir, need not be informed that this decision could not be made without a long and painful struggle as well as mature deliberation; but it is made, and, accordingly, I do hereby resign my command of the naval forces of the United States in these seas, and by this letter communicate officially my resignation to you on whom the command devolves by the law of seniority; reserving to myself, however, the right of reassuming it in case the war should be protracted beyond my hopes and expectations, and my health be fully restored.

The commodore then added:

> The pain inseparable from this act of duty is greatly alleviated by two reflections. First that in having you, sir, for my senior captain, I am enabled to resign my station to an officer who already in a high degree enjoys the confidence of our government. And, secondly, that previous to my resignation the consul-general has expressed his coincidence with the opinion which I officially communicated to him respecting the propriety and policy of meeting the recent overture of the Pasha of Tripoli so far as to offer a negotiation, for which I am persuaded that the present moment is eminently favorable and of the success of which I entertain sanguine expectations, conducted as it will be by a gentleman of such ability, experience, and moderation as Colonel Lear, with the ready assistance and co-operation which I doubt not he will find in your activity and zeal.

[6] Rodgers' Papers, Rodgers to Eaton (undated).

COMMANDER-IN-CHIEF OF THE MEDITERRANEAN SQUADRON (1805-1806).

On May 24, 1805, the frigate *Essex*, Capt. James Barron, with Peace Commissioner Lear as a passenger, sailed from Malta for Tripoli, where she arrived on the 26th. At 10 o'clock a. m. of that day Barron and Lear went aboard the frigate *Constitution* and notified her commander, Captain John Rodgers, that Commodore Samuel Barron had relinquished his office as commander-in-chief of the Mediterranean station and had authorized the beginning of negotiations for peace with the Pasha. Rodgers at once assumed his new command, with the *Constitution* as his flagship. Captain Barron, Lear and the new commander-in-chief then went aboard the *Essex* and stood towards the town, hoisting a flag of truce, which was answered by a similar flag from the Pasha's castle. Soon a boat containing the Spanish consul and an officer of the Pasha came off and boarded the *Essex*. Negotiations for peace were at once begun. In the initial conference, the Pasha was represented by the Spanish consul; but, on Lear's objecting to him, the Danish consul, Nicholas C. Nissen, a good friend of the Americans, took his place. Humiliated by the successes of the navy and alarmed by the movements of Eaton, the Tripolitan ruler was disposed to end the war. He acknowledged that he was defeated and that the squadron then in the Mediterranean was sufficient to reduce his capital. He declared, however, that should his enemy drive him to the last extremity he would retire from his capital with the officers and crew of the *Philadelphia* to a castle in the interior of his dominions which he had prepared for them.[1]

On opening the negotiations Lear rejected the Pasha's original offer of peace for $200,000. After some time had been spent in discussion and bargaining, the peace commissioner stated his ultimatum, and it was accepted. On June 4 a treaty of peace and amity between the United States and Tripoli was signed. It provided that the prisoners in the possession of the belligerents should be exchanged man for man, and that for the excess remaining in the hands of the Pasha our government should pay $60,000. Derne was to be evacuated, and Hamet's family was to be restored to him. The peace established by the treaty was to be on the terms granted by each country to the most favored nations.

[1] Rodgers' Papers, Rodgers to Eaton (undated).

While Lear's treaty was an honorable one and was satisfactory to the government at Washington, its stipulation respecting a ransom was justly objected to by the opponents of the administration. It must be remembered, however, that the practice of ransoming prisoners had at this time the sanction of Christendom, and that by the payment of a small sum of money more than three hundred captive Americans were released, and possibly saved from death, since the Pasha frequently threatened to kill them. Preble had once offered $100,000 for peace. A great advantage was yielded by Commodore Barron when he decided to treat with the Pasha before he attacked Tripoli and while the vessels of the squadron were scattered over the Mediterranean. Under all the circumstances the terms obtained by Lear were as favorable as could be expected. It has been said that his treaty awakened the conscience of Europe. "From the day that it was signed the power of the Barbary corsairs began to wane. The older countries saw their duty more clearly, and ceased to legalize robbery on the high seas. To America the success gave an immediate position which could not easily have been gained in any other way, and, apart from its moral results, the contest with Tripoli was the most potent factor in consolidating the navy of the United States."[8]

The initial conferences were held on board of the *Essex;* but on May 29 the negotiations were moved to Rodgers's flagship, the *Constitution,* and on June 3 the preliminary articles were signed on board that vessel. Commodore Rodgers doubtless aided the peace commissioner with his counsel. Although he supported the treaty, he was not wholly satisfied with it. His views and wishes at this time are disclosed by the following words of Lear, written on June 3:

> This, I believe, is the first instance where peace has been concluded by any of the Barbary states on board a ship-of-war. I must pay a tribute to Commodore Rodgers, whose conduct during the negotiation on board was mixed with that manly firmness and evident wish to continue the war if it could be done with propriety, while he displayed the magnanimity of an American in declaring that we fought not for conquest, but to maintain our just rights and national dignity.

Lear then adds:

> You will pardon me if I here introduce a circumstance evincive of the spirit of our countrymen. At breakfast this morning Commodore Rodgers

[8] Lane-Poole, The Story of the Barbary Corsairs, 291.

observed that, if the Pasha would consent to deliver up our countrymen without making peace, he would engage to give him two hundred thousand dollars instead of sixty thousand, and raise the difference between the two sums from the officers of the navy, who, he was perfectly assured, would contribute to it with the highest satisfaction."

On the evening of June 3 Commodore Rodgers and Colonel Lear went ashore to visit the officers of the *Philadelphia* and congratulate them on their liberation. On the next day a symbol of the restoration of peace was displayed at the American consulate, where a little more than four years before the flagstaff had been cut down, by raising a new flagstaff and again hoisting the American flag. Dr. John Ridgely, the surgeon of the *Philadelphia,* was appointed charge d'affaires. The American prisoners, after a captivity of nineteen months, were released and sent aboard the ships of the squadron. On June 6, Rodgers sailed to Malta in the *Constitution* to fetch the Tripolitan prisoners and the money due the Pasha. He was again at Tripoli on the 17th, and three days later he visited the Pasha and received his assurances of good-will and friendship. On June 21, accompanied by Lear, the commodore returned to Malta.

A few days before Commodore Barron resigned the command of the Mediterranean squadron, he wrote to General Eaton of his decision to begin negotiations for peace and intimated that Derne would in all probability have to be evacuated. He also ordered the vessels that had been co-operating with Eaton to leave Derne and proceed to Syracuse after giving the general an opportunity to embark his forces. This gallant officer, however, was determined not to abandon the captured town and his allies until compelled to do so. On June 5 Commodore Rodgers, thinking that possibly Eaton might be still at Derne, sent the *Constellation,* Capt. H. G. Campbell, to inform the general of the conclusion of peace and to convey him and his party to Syracuse. Campbell reached Derne on June 11, and soon after his arrival received on board his ship Eaton, O'Bannon, and the other Americans of the army, a company of cannoneers, a party of Greeks, and Hamet and his suite of some forty dependents. On June 25 the *Constellation* arrived at Syracuse. Here Hamet and his followers found quarters ashore. Commodore Rodgers allowed him two hundred Spanish dollars a month for his support. The commodore wished to send Hamet to

[a] American State Papers, Foreign Relations II, 718.

America, but, being fearful of a sea voyage he declined to go. Hamet received no little sympathy in the States. In April, 1806, Congress voted him $2400. Some of the critics of the Republican administration contended that he had been unjustly treated and that his cause had been dishonorably abandoned. In view of the hopelessness of his prospects when Eaton found him among the Mamelukes and the little aid that he rendered in the march to Derne and in the capture of that port, it cannot be said that this weak, irresolute man fared ill at the hands of the American government.

While the negotiations with Tripoli were being conducted, Rodgers decided that, if they resulted in the concluding of a peace, he would make an expedition to Tunis, with the ruler of which power he had been having trouble. For several weeks during the early summer of 1805 the commodore was at Syracuse and Malta preparing his fleet for a visit to the Tunisian capital. Various other matters also demanded his attention at this time. The usual disciplinary measures of a fleet in port were to be attended to. A rather important duty that fell to him late in June was the appointing of a court of inquiry to investigate the loss of the *Philadelphia*. Its members were Captains James Barron, H. G. Campbell and Stephen Decatur; and its judge advocate, General William Eaton. Its sessions were held at Syracuse on board the *President*. After examining Lieut. David Porter and several other witnesses, the court decided that Bainbridge had acted with fortitude and good judgment and was not censurable for the loss of his ship.

During his stay at Syracuse and Malta the commodore decided several controversies that had arisen between the commander-in-chief of the squadron and foreign governments over captured vessels. In September, 1804, the *Argus* had taken the ship *St. Miguel*. Some of the subjects of the Czar of Russia claimed her as their property, and Rodgers finally agreed to surrender her to the Russian consul at Malta. In the summer of 1805 the Sublime Porte sent a Turkish frigate to Malta to claim the Ottoman ketch *Gheretti* and two Greek polacres, *La Madona* and *Jebra*. The ketch had aided the Tripolitan gunboats in capturing the *Philadelphia* when she ran aground in October, 1803. Later she was taken by Preble and named the *Intrepid*, and under the command of Decatur she burned the vessel in whose capture she had participated. Finally, Preble converted her into a fire-ship and sent her into the

harbor of Tripoli to destroy the enemy's gunboats, where she blew up, killing Somers, Wadsworth, and Israel. The two polacres were captured by Commodore Barron for a violation of the blockade. Rodgers pacified the Porte by agreeing to give up the polacres and to refer the case of the *Gheretti* to Washington for adjudication.

Another matter that gave the commodore much anxiety at this time was the trial of Lieut. C. L. Ridgely, who in January, 1805, was arrested at Messina and charged with killing George Hutchinson, a mate of an English transport. Protesting his innocence, Ridgely gave himself up for trial. A court constituted by the King of the Two Sicilies tried him and found him guiltless, restoring him (as Rodgers said) "spotless to his country and to his friends."

In July, while the commodore was at Malta with his fleet, several British men-of-war, under the command of Commodore Hammond of the Royal Navy, were anchored in the harbor. The desertion of seamen from one squadron and their enlistment by the other gave the commodores grounds for complaint against each other. Remonstrances and demands for restitution were made on each side. In the end the differences were settled in a manner satisfactory to Rodgers, as may be seen from the following words which he addressed to the Secretary of the Navy: "After receiving the men which I had demanded, it was stipulated between Commodore Hammond and myself that all deserters from our respective squadrons, impressed Americans excepted, should be given up; he saying at the same time that he did not conceive I was bound to give up men which had entered our service in the United States, whatever might have been their previous situation. This is what the British have never in any one instance acknowledged before." During the Barbary wars difficulties with the English over seamen were frequent, but they were not always settled as happily as those between Rodgers and Hammond.

About this time the Mediterranean squadron was considerably strengthened by the addition of several vesesls. An addition made by Lieut. Thomas Robinson of the *Enterprise*, however, did not greatly strengthen the fleet. He purchased at Alcona, in the Adriatic sea, six "miserable, defenceless trabaccoloes and lateen boats," which had neither guns nor crews. Eight gunboats arrived at Syracuse from America between the 7th and 9th of July, all within forty-eight hours of each other. "This," Rodgers wrote, "is a

very extraordinary circumstance and equally worthy of remark, when we consider that they all sailed on different days from all the different principal ports between and including Charleston (S. C.) and Boston (Mass.). In point of effective force and utility they are vastly superior to anything of the kind I have yet seen, and they sail in all respects uncommonly well." It should be said that a gunboat of the old navy was a vessel some 60 feet long and 15 feet wide, carrying from 25 to 45 men and mounting one or two large guns. A ninth gunboat sailed for the Mediterranean, but was lost at sea. About the first of September two bomb ketches, *Vengeance* and *Spitfire*, which Preble had purchased in Boston, arrived at Syracuse.

An unfortunate experience of *Gunboat No. 6*, Lieut. James Lawrence, caused Commodore Rodgers to issue an important order to the fleet. When off Cadiz this vessel was boarded by the British ships *Tenedos* and *Dreadnought*, part of a squadron under the command of Vice-Admiral Cuthbert Collingwood, one of Nelson's commanders. While Lawrence was below with the English officers, three of his men, who had been unruly during the passage, discovering some of their former shipmates on board the visiting boat, declared themselves English subjects with a view to obtaining their release from the American service. One of them claimed to be a deserter from the British frigate *Flora*. The officers, on being told of the declaration of the men, demanded their release, but Lawrence refused to surrender them. Deeming it advisable to state his case to the admiral of the fleet, the young lieutenant, after giving strict orders to his first officer, Midshipman James Roach, not to permit any one to leave the vessel, went on board the British flagship *Dreadnought*. During his absence another English boat came alongside of the gunboat and the three men jumped into it before Roach could prevent them, and were conveyed to the flagship. On learning of the desertion of his men, Lawrence demanded their release, but Collingwood refused to give them up. Lawrence then offered to surrender the gunboat, but the admiral would not accept it. Finally the offended lieutenant returned to his vessel without his men. On receiving an official account of this outrage Rodgers issued the following spirited order to the commanders of his fleet:

An insult offered to the flag of the United States of America on the 12th of June, last, near Cadiz, by a British squadron under the command of

Admiral Collingwood, induces me, as the commander-in-chief of the United States' forces in these seas, to direct that you do not under any pretence whatever suffer your vessel to be detained or your men to be taken out of your vessel without you are compelled so to do by superior force; in which case, having resisted to the utmost of your power, you are directed to surrender your vessel as you would to any other common enemy, but on no account to leave her until after you have struck your colors; after which, if you are not compelled by the author or authors of such insult and violence to quit your vessel, you are directed by me so to do; and going on board the enemy to deliver your sword to the commanding officer of the enemy's vessel, and not return to your own again unless you are absolutely put on board her by force. On saying that you are not to suffer your vessel to be detained, you are not to consider that it extends to the prevention of your giving every satisfaction to the vessels of war you may meet on the high seas whose nations are at peace with the United States, so far as a friendly intercourse will justify.

While the commodore was preparing his fleet for the expedition against Tunis, he ordered several ships to proceed on detached service. The brig *Argus*, Master-Commandant Isaac Hull, was sent to Alexandria with fourteen thousand dollars to pay a debt incurred by Eaton. As a measure of precaution the frigate *Congress*, Capt. Stephen Decatur, and schooner *Vixen*, Master-Commandant George Cox, were directed to cruise off Tunis and guard our interests in that quarter. Capt. James Barron was ordered to convey home in the *President* his sick brother and several of the officers of the *Philadelphia*. Commodore Barron had recently visited Catania and Mount Etna for the benefit of his health. Rodgers always spoke of him in the highest terms and seems to have regarded him as a friend. For Captain James, however, he acquired during this cruise a strong antipathy.

On July 14, 1805, the fleet sailed from Syracuse for Malta, where additional supplies were taken on board, and on the 22d it was ready for sea. The commodore's largest vessel was his flagship *Constitution* 44. Next in size and armament were the frigates *Constellation* 36, Capt. H. G. Campbell; *Essex* 32, Master-Commandant Charles Stewart; and *John Adams* 28, Master-Commandant John Shaw. The small craft consisted of the brig *Siren*, schooners *Nautilus* and *Enterprise*, sloop *Hornet*, transport *Franklin*, and eight gunboats. There were in all seventeen vessels—the largest fleet of the American navy that had ever gone to sea. On board the flagship was Col. Tobias Lear, whose credentials empowered him to adjust terms of conciliation with any or all of the

Barbary rulers. On July 23 Rodgers sailed from Malta, and eight days later, after a tedious passage, arrived in Tunis bay, where he was joined by several other vessels of his squadron. On August 1 the fleet anchored in the road of the Goletta, about four miles from the city.

The Bey of Tunis at this time was Hamuda Pasha, a most interesting character. During his long rule, which began in 1782, he had been frequently at war with the neighboring powers. Like other Barbary potentates in his pride, cruelty, ignorance, religious fanaticism and love of pomp, he was nevertheless in many respects far superior to the generality of them. He had a quick understanding and was able to pursue a course of action with firmness and decision. At times rash and foolish, he was more often prudent and circumspect. One of our consuls said that the Bey was as ignorant as the figure-head of the *Constitution* in respect to letters or the political history or situation of any country on earth beyond the bounds of his horizon, and that he had no knowledge of the strength, wealth and size of the United States. "I do not esteem him a man of duplicity," the consul wrote, "although there is a great deal of what might be styled finesse and court intrigue in him, joined with a degree of candor and simplicity which in my estimation form a strange or rather curious accommodation in his character. It would require a sorcerer to find him out and the Witch of Endor to render him a reason."

In 1797 Hamuda entered into a treaty with the United States, but he soon became dissatisfied with it and began to make unreasonable demands of our consuls for tribute. At times he would threaten war, first blowing hot and then cold. Sympathizing with the Pasha in his difficulties with our government, the Bey viewed with alarm the increase of the American squadron in the Mediterranean and its probable reduction of Tripoli. He refused to recognize Tripoli as a blockaded port, and claimed that it was open to his vessels. He demanded as a right the release of a certain Tunisian xebec and her two prizes that were captured in April, 1805, by our forces, when they were trying to run the blockade; and he charged our consul at Tunis to tell the American commander-in-chief that the Bey would "never cease from his demands whatever the issue." Rodgers wrote to Hamuda that his claims respecting the ships were "wholly inadmissible," and that he intended to convince him that his subjects would be no longer permitted to

"infringe our rights with impunity." The Bey well deserved the chastisement that Rodgers was anxious to administer to him. The peace with Tripoli and the presence of a large fleet in the Mediterranean made it possible for the commodore to take a bold and independent stand.

Soon after his arrival in Tunis bay, Rodgers sent the schooner *Nautilus* to the city to bring off the American consul, Dr. George Davis, who, on August 2, came aboard the flagship and gave a complete account of all his conferences with Hamuda. In conversation with Davis the Bey had recently assumed a most menacing tone. He said:

The President of the United States must know that my father and grandfather have sat on the throne and ruled a kingdom. He shall learn from me that Hamuda is not yet dead, and every crowned head of Europe shall approve the eternal continuance of that war which you seem resolved to force me into; for I solemnly pledge myself that, if war is the result, never while I have a soldier to fire a gun will I accord peace. You may form some idea of my character from the difficulty you had to negotiate a peace because you weakly permitted the Dey of Algiers to interfere. You may also learn my conduct to the Venetians, who rashly forced me into a war; and if I am doomed to engage in another, it shall be continued to the last hour of my existence. I frankly tell you that the famine in my country has prevented my declaring war against you, in order that I might convince my subjects that their miseries should not be increased unless I was forced thereto. Without such a motive you certainly never would have been asked the reason why you captured my vessels, but that a just motive to a protraction of our difficulties must be sacrificed to those considerations which I owe myself and all Europe. You are the first power which has ever captured a Tunisian cruiser in full peace on any pretext whatever. You are the first that has ever offered unprovoked insults to Hamuda Pasha, who has ruled a kingdom for twenty-seven years and been respected by all the world as a sovereign. If I was tamely to submit to such acts of outrage, what should I expect from nations far more powerful than yourselves?[10]

After conferring with Davis, the commodore summoned Colonel Lear and the senior commanders of the squadron to a council of war on board the *Constitution*, and submitted to them all the information respecting the conduct of the Bey that he possessed. The council of war decided that the commodore should send the following spirited ultimatum to the Bey:

It is with equal pain and astonishment that I was yesterday made ac-

[10] See Rodgers' Papers for this and succeeding quotations respecting the negotiations with the Bey; also Goldsborough's Naval Chronicle, 279-287

quainted by George Davis, Esq., charge d' affaires to your court, with your declaration wherein you informed him that my appearance here with the squadron under my command would determine an immediate declaration of war on your part. If this be the case, those explanations which brought me here, and which I had hoped would re-establish a good understanding between your excellency and the government of my country, are unnecessary, as it now only rests for me in justification of my conduct to request that your excellency will have the goodness to inform me whether there has been any mistake in the application of your assertion tending to a declaration of war with the United States; as your excellency will without doubt see the propriety, as also the necessity, on my part of commencing both defensive and offensive operations against your regency in the course of thirty-six hours, should I not hear from you on this important and equally (to me) painful subject.

Rodgers considered the language of the Bey highly insulting to our government. He said:

Indeed, so much so as ought in my humble opinion to have induced Mr. Davis (particularly as he knew the force we had near at hand, and being previously informed of my intentions) to have taken his leave. This would have given me an opportunity to have assumed entirely a different posture. . . . . War was the interest of the United States, and had Mr. Davis have left the regency at a moment when such violent threats and gross insult were offered, I should have had a fair pretext for discussing the subject by the language of our cannon—the only language capable of making an imperious Barbary pirate correct his conduct. . . . . Until the day of my death I shall lament that our affairs were now at a point which required decisive measures, yet nevertheless it required the authority of government to authorize my drawing the sword of the nation in defence of its honor and interest at a moment when I knew our force was sufficient, in ten days, to have made him call for mercy on his bended knees.

With Rodgers's letter, dated August 2 (and also with one written by Lear of the same date) Davis repaired to the royal palace. On receiving it the Bey explained that neither he nor his Christian secretaries understood English; whereupon, Davis volunteered to give him its substance, which he proceeded to do. Hamuda replied at once. While his words were free from menace, they were nevertheless strong and bold. Skilled in the tactics of diplomacy, he chose his position with excellent judgment. He said:

The commodore stipulates thirty-six hours for my answer. If he will have it in the Turkish or Moorish language, it shall be given immediately; but there is no Christian clerk at this time to write him. I, however, will give you my answer by word of mouth and beg you to communicate it. My conduct shall be guided wholly by the letter and spirit of the treaty;

and I have already taken the measures which it points out, to wit, a proper representation to the President of the United States for redress of grievances. Until an answer is received from him, I shall strictly maintain the peace which exists between us; but, if your commodore attacks or detains any of my vessels, cruisers, or merchantmen, or fires a single gun with a hostile intention, that instant your flag shall be hauled down. I will hold no converse with him, either relative to peace or war, change of treaties, or any other public concerns, excepting on the subject of the captured vessels. No hostilities shall be commenced by me. His boats may pass freely and without any kind of interruption. It, therefore, rests with him to respect the treaty made by his master, or not; for although I am resolved not to provoke a commencement of hostilities, still I shall not shrink from it when properly invited. I made the treaty with the President of the United States, and not with the commodore.

On the receipt of Hamuda's reply, Rodgers called another council of war. It took the position that the Bey's language expressed his desire to avoid hostilities. It decided, however, that his word alone was not sufficient, and that he should be required to give a written guarantee of his intentions to maintain peace, duly witnessed by the British and French consuls. On August 4, the commodore gave instructions to Davis in accordance with the council of war's decision. In case the Bey refused to give the guarantee, the consul was to inform him that his capital was to be blockaded and his cruisers prevented from injuring American commerce until the commander-in-chief should receive instructions from Washington. After Davis had gone ashore Rodgers decided to be more specific in his demands. He, therefore, prescribed the following form of guarantee and gave the Bey three days within which to sign it:

Whereas the commander-in-chief of the squadron of the United States of America now lying in Tunis bay had been induced to believe that it was my determination to declare war against the said United States in consequence of one of my cruisers and her two prizes having been detained by the aforesaid squadron in their attempting to enter Tripoli during the late blockade of that place, or some other cause, I do hereby solemnly declare that it is not my intention and that I will not commence hostilities or declare war against the said United States so long as the treaty existing between myself and the said United States shall be faithfully adhered to by them, and not until I shall have made an application to the government of the United States for redress of any injuries which I may receive or have received from the said United States and have been refused such redress.

Captain Stephen Decatur was chosen to carry the guarantee to

Davis, and he was instructed to be present as Rodgers's representative when it was presented to the Bey.

In the meantime the Bey had read the letters of Rodgers and Lear of August 2. From the communication of the consul-general he learned that Lear was empowered by his government to treat with him. For this, or some other reason, his replies were quite conciliatory, and in marked contrast with his verbal answer to Davis. He now assumed that the visit of the squadron to his capital was a friendly one, and was designed to adjust harmoniously the existing differences between the two governments. His letter to Rodgers, dated August 5, read as follows:

In answer to your letter, dated 2d of August, which I received the day before yesterday, I declare it was never my intention to refuse seeing or treating with you any time you presented yourself in a friendly manner, that is with only a part of your squadron, as I have always had the pleasure of seeing done by commanders sent by other powers, my friends. But it is certain that I have positively declared to the person charged with the affairs of your government, residing here, that I did not know how to tolerate your presenting yourself in a hostile and powerful manner, as you now have done with all the force under your command, when there was no reason for so doing, except that of a friendly treaty to be decided on: for it is by explanation and clearness of different points that the consolations of good harmony, which happily subsist between your government and me, are to exist and more and more augment. This, for my part, I have always maintained and will maintain, according to the tenor of the stipulated and solemn ratification of our treaty. But I am now informed that Consul-General Lear is invested with the power to make with me a final treaty; in consequence of which I invite him to come in person in the character which is conferred on him by the President, that he may explain to me the desires of the same. With pleasure I declare if you find it proper to accompany him you will be very welcome, and would give me a particular pleasure. In the meantime I have the pleasure of wishing you all happiness.

An August 7 Davis returned to the *Constitution* without having procured the Bey's signature to the written guarantee. The Bey had declined to receive Captain Decatur as Rodgers's official representative, and the captain had in a most spirited manner refused to visit him in any other capacity and had at once returned to the flagship. This action greatly alarmed the Bey, who sent a messenger post-haste to Lear with a most conciliatory letter. He declared that he wished to see the consul-general and speak with him and listen to his explanations. "Be so good," he wrote in conclusion, "as to make my compliments to Commodore Rodgers and

inform him that I also wrote to him the day before yesterday and have no doubt but that the messenger has consigned to him my answer."

The commodore decided to insist on the signing of the guarantee. Accordingly on August 8 he gave Davis the following instructions:

As I have not received that satisfaction from His Excellency, the Bey of Tunis, which the nature of our affairs requires, I now am induced to desire that in case he does not give you the guarantee by to-morrow at noon which you have been directed to demand, you inform him that no farther advances will be made by me, and that in consequence of his refusal you are directed to repair on board the squadron to-morrow by 4 o'clock p. m.

Davis went again to the palace and presented the guarantee to Hamuda, who refused to sign it in the presence of the British and French consuls, declaring that his seal was sufficient authentication. Our consul thereupon took final leave of the Bey, collected his baggage, and, accompanied by his secretary and dragoman, went on board the flagship.

Rodgers wrote:

It was now that I saw our situation was such as to require the most decisive measures, at least to a certain extent; and this I was enabled to express by a brig (whose colors I could not distinguish, but believe that they were Rigutian) that got underweigh, which I fired two shots at, conceiving at the time that she had been ordered to get under sail in order to prove whether I would verify my last declaration, of which Mr. Davis was the medium of conveyance and which produced the cessation of his functions. . . . I now ordered the *Nautilus*, Captain Dent, to get underweigh and lay off the entrance of the bay and to board all vessels going out, and if they belonged to Tunis and were armed in any shape, to send them into port again; and all ships coming in, and if belonging to Tunis to ascertain whether they had committed any depredations on our commerce, previous to suffering them to pass, and, at any rate, if Tunisian cruisers, to oblige them to return into this port. On the morning of the 10th of August the *Vixen*, Captain Cox, and *Enterprise*, Captain Robinson, were directed to get underweigh and cruise at the entrance of the bay under the same orders which Captain Dent had received the preceding day. At noon, about two hours after the sailing of the two latter vessels, the Bey sent by express letter "L" directed to Colonel Lear, and by which you will discover the panic that had taken possession of his royal breast.

The communication of the Bey to which Rodgers refers is a lengthy one, and is dated August 9. In this the Bey declares that some misunderstanding of his intentions or his language must cer-

tainly have arisen. He reiterates his sentiments of peace and friendship, and he insists that he has kept his treaty with the United States. He says that he is quite willing to negotiate with Lear. Most important of all are his concluding words, for they formed the grounds of a compromise:

> More again to convince you of my peaceable intentions and good friendship and also the esteem I have for the President, whatever may be your intentions or that of the commodore no more to treat with me until new orders are received. After what has happened, I propose to you to send a person of distinction of my regency to your government to explain and accommodate, which will accelerate the final depending between us. If the commodore will receive him on board his or any other vessel of the squadron, on his advisal he shall be immediately sent; but if not, I will dispatch him in a vessel chartered by myself for that purpose.

Rodgers now decided to waive the guarantee and to begin negotiations. On August 12 Consul-General Lear, accompanied by Chaplain Cruize of the *Constellation,* went ashore; and on the two succeeding days he held conferences with the Bey, in which the differences between the two governments were thoroughly considered. At one time during the negotiations Hamuda was disposed to withdraw his proposal in respect to the sending of an ambassador to the United States. Believing that the wiley ruler was equivocating, Rodgers wrote to Lear that Hamuda must do one of three things by simple request, or else do all three by force:

> He must give the guarantee already required; or he must give security for peace and send a minister to the United States; or he must make such alterations in the treaty as you may require. I have only to repeat that, if he does not do all that is necessary and proper, at the risk of my conduct being disapproved by my country he shall feel the vengeance of the squadron now in this bay.

The agreement reached by Lear and Hamuda was in conformity with the commodore's second demand. The Bey agreed to send an ambassador to Washington to adjust there all differences between the two governments, and to give the commodore assurance that he would maintain peace agreeable to the treaty of 1797. On August 14 he wrote Rodgers the following conciliatory letter:

> Leaving to Consul-General Lear the care of informing you how long and friendly were our conferences of yesterday and to-day, I limit myself by the present to confirm in the most solemn manner that which I have wrote to you, and the same to Consul-General Lear, assuring you that it was never my intention to declare war against your nation nor to begin any

hostilities if not first provoked on your part. I conclude this misunderstanding between us must have originated from those who have not well understood or well remembered my words, or my writings not being well understood or explained. In this state of affairs, and to dispel all shade of coldness or misunderstanding between the two nations, I have resolved to send, without delay, an ambassador to the President of the United States to make a reclamation relative to the xebec and two prizes in question. I do not hesitate a moment in giving you my word of honor and that of a prince, as I reciprocally demand of you, that I will not commit any hostilities whatsoever or make the least change in the present peace existing between us until the return of my ambassador from your country with the ratification of peace or some other propositions or determinations of the President. Be pleased then, in this interval, to send me a charge d'affaires, until there is by the President chosen, named, and sent to me a consul. With confirming the above said, I salute you and wish you happiness.

On August 15 Colonel Lear returned to the flagship and reported that his mission had resulted satisfactorily. The commodore at once called in the cruisers that he had stationed at the mouth of the bay and suspended all defensive operations. He appointed Dr. James Dodge, the surgeon of the *Constitution,* to act as charge d'affaires at the court of Tunis. The Bey chose as ambassador to America Suliman Mellimelni, a distinguished Tunisian soldier and statesman. He had formerly commanded his master's army, and had fought gallantly in his country's wars with Algiers and Turkey. On August 27 Mellimelni paid Rodgers a visit of respect on board the *Constitution.* The yards were manned and a salute of eleven guns were fired in his honor. After inspecting the ship and dining with the commodore, he returned to Tunis. On September 1 the ambassador and his suite embarked for America on board the frigate *Congress,* Capt. Stephen Decatur. She sailed on September 5 and arrived at Washington on November 29.

The expedition to Tunis ended with the sailing of the *Congress.* It had resulted in giving the Bey an impression of the strength of the United States that was a revelation to him. He now took pains to collect much information respecting the size, situation and resources of our country. The foreign consuls at Tunis were much astonished at Rodgers's success, and some of them said that no other nation had ever negotiated with Hamuda on such favorable terms. Formerly, the corsair rulers had refused to deliver to our agents in Barbary American vessels wrongfully captured; now, one of these potentates was sending an ambassador to America to reclaim Barbary vessels legally captured. "It must be mortifying

to some of the neighboring European powers," our consul at Tripoli wrote to Rodgers on hearing of the result of the expedition, "to see that the Barbary states have been taught their first lessons of humiliation from the Western World."

As soon as the affair with Tunis was settled, Rodgers reorganized his squadron. The frigate *Essex*, Capt. H. G. Campbell, and the schooner *Vixen*, Master-Commandant George Cox, were stationed at Gibraltar to protect our commerce in that quarter. The frigates *Congress*, *Constellation* and *John Adams*, and brig *Franklin*, were sent home. The rest of the fleet, under the immediate command of the commodore, remained up the Mediterranean with his headquarters at Syracuse. This division contained the flagship *Constitution*, the brig *Argus*, Master-Commandant Isaac Hull; schooner *Enterprise*, Lieut. David Porter; brig *Siren*, Master-Commandant John Smith; schooner *Nautilus*, Lieut. Samuel Evans; sloop *Hornet*, Lieut. W. M. Crane; eight gunboats; and the bomb vessels *Vengeance* and *Spitfire*. During the ensuing winter Rodgers increased his forces by placing in commission some of the small craft that had been purchased in the Adriatic.

Early in September the *Constitution* sailed from Tunis for Syracuse, and thence to Leghorn by way of Messina and Naples. The chief object of the commodore's visit to the Italian ports was the procuring of money for the squadron from the American agents residing there. Colonel Lear, who was returning to his post at Algiers, accompanied him, wishing to purchase in Italy, the biennial present now due the Dey. At Leghorn Rodgers was grossly insulted by the military authorities. Twice in attempting to enter the city, he was rudely turned back by a guard of soldiers and refused admittance. Mortified at such treatment, he appealed for redress to General Villette, the chief officer of the city. Not obtaining it, he tartly informed the general that an American commodore possessed the power of opening city gates with as much facility as the governor of Leghorn. Finally, Rodgers appealed his case to the First Minister of the Queen Regent of Etruria, but the *Constitution* sailed before the difficulty was settled. The only other instance in which our commanding officers met with disrespect from Italian port officials occurred at Genoa. The commander of the *Siren*, which vessel by the way was the first ship of our navy to visit the birthplace of Columbus, was badly treated by the French agent at that place.

The *Constitution* left Leghorn on November 9 and eight days later arrived at Algiers bay. A sudden gale, however, forced her to put to sea, and she did not come to anchor until the 19th, when Colonel Lear disembarked. During his absence from his post the Dey had been assassinated, and a new ruler, the private secretary of the old one, had assumed the supreme power. The new Dey received Lear with manifestations of respect and friendship. Since our affairs with this regency were on a satisfactory footing, the commodore made but a brief stay. On November 20 he sailed for Syracuse where eight days later he rejoined his squadron.

Busy with his naval duties, Rodgers spent the ensuing winter and spring chiefly at Syracuse. Occasionally, however, he visited Malta, where he was cordially received by the English governor and his wife, Sir Alexander and Lady Ball. This official, who had been one of Nelson's captains, manifested much interest in our officers and navy during the Tripolitan war. He had been exceedingly attentive to the needs of Commodore Preble, who on his return to America purchased two fishing smacks for the governor and sent them to him as an expression of the American government's appreciation of his kindness. To Rodgers fell the duty of delivering the vessels. Sir Alexander was greatly pleased with the gift and he wrote the commodore a very handsome letter expressive of his gratitude.

During his stay at Syracuse, Rodgers found active employment for several of the smaller vessels of his fleet. First the *Argus* (Hull), and later the *Enterprise* (Porter), was sent to Naples to protect our interests there in the winter of 1805-1806, when Joseph Bonaparte and a French army took possession of the city. Now and then vessels were ordered to the straits, the Barbary capitals, and the Italian ports, to communicate with our officials. In this way the commodore kept himself in touch with affairs in the Mediterranean. The first vessel to visit Tripoli after peace was restored was the *Enterprise* (Porter). She returned to Malta in the fall of 1805, bringing word that the Pasha was still kindly disposed towards us. She was followed by *Gunboat No. 8*, which vessel, Rodgers wrote, excited much curiosity at Tripoli. "She was saluted with twenty-one guns on her arrival, which she returned in so handsome a manner both as to time and regularity that the most knowing of the Tripolines observed that it would have done no discredit to a ship of the line. The Pasha observed that she

was very different from his boats and requested permission to have a draft taken of her by his Spanish carpenter. Lieutenant Haraden, her commander, informed him that this he could not permit wqithout my consent, but gave permission to examine her. While *No. 8* lay at Tripoli one of her marines deserted and took the necessary steps to constitute himself a Turk, and afterwards got to the Pasha's castle and demanded protection. However, after a remonstrance by Mr. Ridgely, our charge d'affaires, he was delivered up by the Pasha in direct opposition to their religious and civil laws, the Pasha asserting, I understood from Lieutenant Haraden, that he would not have done the like for any other Christian nation."

While Rodgers was in command of the squadron, peace and harmony prevailed among its officers, and the discipline on board its vessels (to use his own words) "would not have done discredit to a much older service than our own." That this state of affairs was exceptional the letters written home by some of the officers in the early part of the Tripolitan war plainly reveal. The following extract is from a letter of an officer of the *New York*, dated March 26, 1803:

> While lying at Malta, Lieutenant Van Dyke and the first lieutenant of marines, Mr. Osborne, went on shore to settle a trifling dispute. After exchanging four shots, Lieutenant Van Dyke received a ball in his right thigh, which passed through and was extracted from his left, which terminated his existence after an illness of three weeks. About the same time a duel was fought between Mr. Bainbridge, a midshipman of the *New York*, and Mr. Cochran, an English gentleman. The latter was the challenger and was killed.

The commodore was always a rigid disciplinarian, and his ships were models of order, neatness and regularity. He took much pride in his profession, and he exacted of his officers an unhesitating obedience and a minute observance of naval customs. Quick to discern merit and to reward it, he was equally quick to discover weakness and negligence and to censure them. Of his younger commanding officers, he valued most Hull and Porter. On one occasion he spoke of Lieut. James Lawrence as an officer from whom his country had much to expect. Impressed by the superior qualities of O. H. Perry, he ordered him to report for duty as a lieutenant on board the flagship, and when the commodore shifted his pennant to the *Essex*, that promising young officer went with him. Besides Perry, Lieuts. David Porter and

Edward Trenchard, and Midshipmen John Downes, G. W. Rodgers, and J. J. Nicholson served on board the *Constitution*. All of these officers later reached the highest naval rank.

Never touching strong drink himself, Rodgers had little sympathy for any one who used it to excess. In the fall of 1805 he sent the lieutenant-commandant of the *Spitfire* home as a punishment for intemperance. On that vessel's passage to the Mediterranean, her commander had at times been so drunk as to be unfit for duty. He had delayed the progress of his vessel in order to keep company with the master of a merchantman, whom he invited to dine with him. "This latter circumstance alone," Rodgers wrote, "considering the orders he was under at the time, is proof positive that he is not, to give it no harder name, calculated for the service."

The five months that Rodgers spent at Syracuse was a period of much anxiety to him. In the fall of 1805, soon after the news of the peace with Tripoli reached Washington, Jefferson ordered all the vessels of the Mediterranean squadron to return home, with the exception of three—a frigate and two small craft. Since these orders were issued before the President learned of the expedition to Tunis, the commodore felt justified in delaying their execution. He believed that it was imprudent to reduce the squadron until the return of the Tunisian ambassador and the ratification by the Bey of the measures agreed to by his agent and the American government. He expected Jefferson to take a similar view when he learned all the circumstances of the Tunisian affair and to countermand his previous orders. All winter the commodore awaited the receipt of fresh commands from Washington. Spring came, and still no letters. There was nothing to do, but to execute the orders of the previous fall. He, therefore, prepared his squadron for its return home.

After abandoning the naval hospital at Syracuse and settling the naval accounts at that port and at Malta, the commodore on May 1 sailed with his fleet for Gibraltar, calling on his way at Tunis and Algiers. At the latter capital, accompanied by Lear, he paid a visit to the new Dey who showed him much civility, and consented to receive him wearing his sword. "I am the first Christian," Rodgers wrote to the Secretary of the Navy, "that has ever been permitted to visit the Dey of Algiers with side arms, and I think it worth remarking to you, particularly as I have reason to believe he had understood by Colonel Lear's drago-

man that a refusal to receive me with my sword would be to him a deprivation of my intended visit." The squadron arrived at Gibraltar on May 21.

Here Rodgers received a brief letter from the department implying that its previous orders were to be executed. While he had a naval man's respect for his official superiors and seldom criticised them, he did on this occasion express warmly his disapprobation of the policy of his government, as may be seen from the following words addressed to Lear: "No doubt the gunboats will be sent directly back to the Mediterranean after their arrival in America. This is singular work. God help our country!" On May 27 he removed his pennant to the *Essex* and gave Captain Campbell command of the *Constitution* and of the squadron that was to be left in the Mediterranean, which, in addition to the flagship, was to consist of the *Enterprise*, Master-Commandant David Porter, and the brig *Hornet*, Lieut. J. H. Dent. On May 28 the *Argus* and *Siren* sailed for America. Owing to adverse winds, Rodgers did not weigh anchor until June 3, on which day the *Essex*, *Vixen*, *Vengeance*, *Spitfire*, sloop *Hornet*, and the eight gunboats went to sea. They were soon followed by the *Nautilus*. After seeing the ships under his immediate command safely out of the straits, the commodore parted company with them, having ordered Master-Commandant George Cox to conduct them to Charleston, S. C. The *Essex* reached Washington on July 27, 1806.

It had now been more than two years since Rodgers left America. His naval service during this period had been most varied and arduous. As senior officer under Commodore Barron, he had commanded the blockading squadron off Tripoli. When suddenly called to assume the duties of commander-in-chief, he had carried out his predecessor's policy and had assisted Lear in making a permanent peace with the Pasha, and in obtaining the release of more than three hundred captive officers and seamen. He had brought before Tunis the largest fleet of American naval vessels that had ever been assembled, and under the mouths of his cannon had conducted a successful negotiation with the astute ruler of that country. In the performance of these and many other duties, the commodore had exhibited energy, skill, resource, decision, power of combination, and ardent devotion to his government's interests. His fellow-officers freely expressed their

appreciation of his sterling character and substantial services. The principal lieutenant-commandants of the fleet united in writing him a friendly letter approving of his conduct and testifying to their high regard for him, and he received several similar communications from the officers of the *Constitution*.

A few weeks after Rodgers arrived in America the Tunisian ambassador, Mellimelni, sailed home, after a stay of about nine months. On establishing himself in Washington, in November, 1805, the ambassador formally demanded of our government the restoration of the three vessels whose ownership was in dispute. To conciliate the Bey, Jefferson relinquished all claims to them. Encouraged by his success, Mellimelni asked for a supply of naval stores as the price of a three-years' peace. This was too much for even our peace-loving President, who refused to grant the extortion. Later, however, his resolution weakened, and he decided to give the Bey the brig *Franklin* and a load of naval stores, and to send the ambassador home on board of her. This plan was abandoned when Mellimelni refused for some trivial reason to return in this manner. Finally the government chartered the ship *Two Brothers* and indulged the ambassador to the extent of furnishing him with an agent to purchase a cargo and of permitting him to load it on board the ship and have it conveyed to the Mediterranean, where he doubtless realized a handsome profit on his venture. In September, 1806, the *Two Brothers*, with Mellimelni as a passenger, sailed from Boston for Tunis.

The Bey's ambassador attracted much attention in Washington and other eastern cities which he visited. He was one of the first African potentates to honor this country with his presence. His stay at the capital afforded much amusement to its inhabitants, who long remembered his strange costumes, his Arabian horses, his oriental customs, and his peculiar prayers and religious exercises. Among his attendants was a passionate fellow named Hadji Mohammed, who quarreled with a barber and threatened to kill him. The barber complained to Secretary of State James Madison, who sent one of the officials of his department to call upon Mellimelni and request him to curb the impetuosity of his follower. The ambassador received the official with the usual forms of oriental politeness, and having heard his complaint spoke a few words to one of his attendants, who went out and presently returned with poor Hadji Mohammed guarded by four Tunis-

ians with drawn swords. The official, who was a mild and gentle man, was greatly alarmed at this spectacle. He was still more shocked when Mellimelni expressed a desire to please the American government and offered to have the culprit's head taken off at once and sent to Madison, unless the Secretary of State or the President might prefer to witness the decapitation. The frightened official hastened to assure the ambassador that no such reparation was demanded, and that it was only necessary for him to enjoin his attendant to refrain from acts of violence.

Jefferson's friendly yielding to the demands of Mellimelni is one of many indications that he did not enter into the commodore's plans and wishes to discipline the Bey of Tunis by the use of force. In his annual messages he made no mention of the Tunisian expedition. He did not publicly commend Rodgers for his efficient services in ending the war with Tripoli and in humiliating the Bey. It ill befitted the peaceful President, now embarked on his cheese-paring naval policy, to welcome home the returning hero.

With the arrival of Rodgers's fleet in the United States in the summer of 1806, our wars with the Barbary states came to an end. No other officer played so large a part in them as Rodgers. As senior officer under Morris and Barron, he served as their "chief of staff" and as commander of the blockading fleet off Tripoli. He was three times commander-in-chief of the Mediterranean squadron. Two of the largest cruisers of the Pasha's navy and several smaller craft surrended to him. In settling our difficulties with Morocco he shared the honors with Preble; during the peace negotiations with Tripoli he commanded the American squadron; and in the expedition to Tunis he was the chief actor and the officer in command. Commodore John Rodgers must always be given a conspicuous and honorable place in the history of our wars with the Barbary states. He it was, who, with Preble, humbled the proud and insulting corsairs, set an example to all Europe of a spirited and forcible resistance to extortion and blackmail, strengthened abroad our reputation as a nation for military courage and political initiative, and popularized, trained and consolidated our infant navy.

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A FAIR BASIS FOR COMPETITION IN BATTLE PRACTICE.

By CAPTAIN BRADLEY A. FISKE, U. S. Navy.

There are two reasons for having competition in target practice. One reason is that competition produces emulation and thereby increases skill; and the other reason is that the results obtained give data, not only as to what any given ship or gun can do, but also as to the ways in which the personnel and the material can be improved.

This presupposes that the basis for competition is fair, and scientifically correct, or as nearly so as possible; because if the basis be not fair and correct, discontent will be aroused, and the data gotten may lead us to very erroneous conclusions, as to both the personnel and the material.

In order to reason out, if possible, a correct basis for competition, we must first recognize the fact that, in any competitive exercise, the intent is to find out and evaluate correctly the relative degrees of skill or prowess of certain contestants; and that, in order to do this, their skill or prowess must be tested under conditions which give no advantage to any contestant. In other words, we must recognize as the indispensable basis the fact that the conditions of the test must be the same for all, or as nearly the same as possible. This fact is recognized in all competitions, all over the world; and it is so thoroughly established in our own minds, that none of us can even imagine any fair competitive exercise, in which the skill of the contestants would be tested under diverse conditions.

It is true that, in many competitive exercises, one contestant has some extraneous advantage over another, which cannot be prevented or ignored. It is usual in such cases to impose a handi-

cap. In deciding on this handicap, it is necessary to evaluate correctly the character and the amount of the extraneous advantage, and to counterbalance it by a handicap of the same character and amount; or, if this cannot be done, to multiply the record of each contestant by some mathematical factor, which equals the inverse of the ratio of extraneous advantage possessed by that contestant.

Passing to the application of these ancient principles to our competitive battle practice, we see at once that any ship's skill at hitting a target may be divided into two parts; one, the skill of the gun-crews, and the other the skill of the fire-control party in giving the gun-crews the correct sight-bar range. We also see that, in order to reason out a fair basis, these two factors must first be considered separately because they are separate though they act together.

Leaving out the question of rapidity, and considering only the skill of the gun-crews, *per se*, in firing accurately, we see at once that it is perfectly easy to reason out a fair basis; for it is clear that, so far as the gun-crews themselves are concerned, all main battery guns ought to fire at targets of the same dimensions, at the same distance; because all that any gun-crew can do is to fire the gun at the correct angle of elevation. This presupposes that the correct sight-bar range is given to the guns. Of course, this may not be done; but this concerns the second factor, the skill of the fire-control party, not of the gun-crews, and will be considered separately.

Therefore, leaving out of consideration the highly improbable and unusual case of a sight-setter not setting the sight at the range given by the fire-control party, and also the insignificant effect of the wind, the only probable thing which causes a gun to miss the target is the failure of the gun-pointer to press his button at the correct instant; because, no matter what kind of gun the pointer fires, no matter what the initial velocity, no matter what the angle of fall, the projectile must hit that part of the target, at which the gun was pointed when the projectile left the muzzle. If a 12-inch high-powered gun and a 6-inch low-powered gun are fired at two targets, of the same dimensions, at the same *known* distance, under the same conditions, and with the same degree of skill, the projectiles must go to the same places on their respective targets. Therefore, *so far as the gun-crews alone are concerned*, all main-battery guns should fire at targets of the same dimensions at the same distance.

Passing now to that part of the battle practice which concerns the fire-control, let us recognize the fact that the first thing, and almost the most important thing, is to get the correct sight-bar range as soon as possible. If one ship's range-finder gives the opening sight-bar range only 100 yards wrong, while another ship's range-finder gives it 200 yards wrong, the first ship starts with an initial advantage over the second ship. Now, remembering that the inaccuracy in finding the range varies as the square of that range, we see that, *so far as this factor alone is concerned*, the distance should be the same for all ships; because, otherwise, one ship would be placed at a disadvantage in regard to another in the very beginning. For instance, suppose that one ship had an opening range of 6000 yards, and another ship of 8000 yards, and that their range-finders were used with equal skill. Then the range-finder error of the second ship would be $\frac{80^2}{60^2}$ as great as the range-finder error of the first ship; so that, if the first ship should start with an error of 100 yards, the second ship would start with an error of 177 yards. The disproportion would really be greater than this, for the reason that the above law is true only when the atmosphere is perfectly clear. Under ordinary conditions of the atmosphere, the error increases more rapidly than the square of the distance, for the reason that there are more particles of water between the eye and a distant target than between the eye and a near target. To take as an illustration an extreme but not unusual case, the state of the atmosphere is such, sometimes, that the distance of a target 6000 yards away could be measured with considerable accuracy, while a target 8000 yards away could not even be seen.

Passing now to the conditions of target practice after spotting has begun, it is plain that a like reasoning leads us to the conclusion that the only correct basis for competitive spotting is that the targets should be at the same distance; for it is manifest that the error of spotting increases as the distance increases.

There has been some debate as to how rapidly the error of spotting increases with the distance. The writer feels sure that spotting is only a form of range-finding, and that the error increases as the square of the distance. Certainly, if an observer occupies a station, say 90 feet above the sea, and a number of buoys be placed 100 yards apart along his line of sight, it is a

fact which can be demonstrated by simply drawing a diagram (Fig. 1), that the distances between those buoys would appear to be inversely as the square of their middle distance; that is, if there were two buoys 100 yards apart whose middle distance was 6000 yards, and if there were two other buoys whose middle distance was 8000 yards, the first pair of buoys would seem to be 1.77 times as far apart as the other pair; so that, even if an observer knew that the two pairs of buoys were the same distance apart, he would probably make 1.77 times as much error in estimating that distance, if he used the more distant pair alone for making his estimate, as if he used the nearer pair alone. It is a law of Nature that, in measuring any distance, by any means, by any instrument, by any method, the error made in measuring that distance must vary as the square of that distance from the observer; even if the observer knows the dimensions of the object observed, as when using the stadimeter, or when spotting the distance of a splash from a target of known height.

FIG. 1.

It is claimed by some that the error does not increase so rapidly as the square of the distance; the idea being that the spotter, knowing the vertical height of the target, will estimate that the projectile falls below the bottom of the target, say one-tenth of the height of that target, say three feet; so that the error which the spotter would make would be simply a certain proportion of this height, say one-third, that is, one foot, whether he was spotting at 6000 yards or 8000 yards. This idea seems to be held unreasoningly; because a man cannot estimate three feet as accurately at long distances as at short distances; but even if he could, it is surely clear that, as may be seen by drawing a simple diagram (Fig. 2), this vertical error of one foot would mean a range error $\frac{80}{60}$ as great at 8000 yards as at 6000 yards. That is to say, even under this assumption, a spotter's error in estimating this vertical distance which would cause a range error at 6000 yards of 100 yards would cause a range error at 8000 yards of $\frac{80}{60}$ of 100 yards, or 133⅓ yards.

Furthermore, by reason of haze in the air, and the interference of waves with the line of sight, it must always be more difficult to see clearly the bottom of a target at 8000 yards than at 6000 yards; and therefore more difficult to estimate correctly any distance from it where a splash may appear.

We may conclude, therefore, that:

(a) In order that fair competition may exist among the gun-crews, considered apart from the range-finders, spotters and fire-control party, the rational plan would be to have all guns fire at the same kind of target at the same distance; and

(b) In order that fair competition may exist among range-finders, spotters and fire-control party, the rational plan would be to use the same kind of target, placed at the same distance.

But, while this reasoning seems to show that the same target and the same distance should be used in carrying out either kind of practice separately, we know that in battle practice we do not

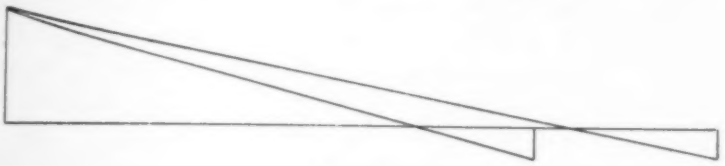

FIG. 2.

use them separately but together. The problem therefore is to find a fair basis for competition when using them together; that is, when both the gun-crews and the fire-control party are making errors. The two errors combine to make the total error, which is evidenced only by the amount by which the projectile misses the center of the target. In the case of any one shot, we cannot separate or analyze the two errors. But we know that any error in sight-bar range makes more difference to a low-powered gun than to a high-powered gun; because, with a target at a given distance, any given error in sight-bar range causes a less change in the height of impact of a high-power projectile than of a low-power projectile, in a ratio practically equal to the ratio of their angles of fall.

With the idea of putting different classes of guns on a fair basis, it has been proposed to have them fire at targets of the same dimensions, at different distances; for instance, at targets placed at such distances that the angles of fall for the principal guns of

the ships will be the same. But it must be clear that this cannot accomplish the purpose; because targets placed at different distances subtend different angles, not only in the vertical plane, but also in the horizontal plane.

By firing at targets at different distances, not only would the gun-pointers have targets subtending unequal angles, in both the horizontal and the vertical plane, but the clearness and brightness of the more distant targets would be less than the clearness and brightness of the nearer targets, making it more difficult to point at them correctly and, sometimes, very much more difficult. Furthermore, if the targets were placed at such distances that the angles of fall were the same, then it is rigorously true that their distances ought to be obtainable with the same accuracy; but if one target be at 6000 yards, and another at 8000 yards, their distances cannot possibly be obtained with the same accuracy, either by range-finder or by spotting, as has just been shown; and the ship with the nearer target would be given an advantage over the other ship. Therefore, if we attempt to compensate for unequal initial velocities and weights of projectile by placing the targets where the angles of fall would be the same, we shall defeat our object.

The question now arises, could we accomplish our object by firing all guns competing in the same class at targets of the same dimensions, at the same distance, and handicapping, in any way, the guns that have flat trajectories?

To clear up the question a little, let us recognize the fact that, at battle practice, the gun-crews and the fire-control parties are cooperating, and that it is impossible to tell whether any one miss was due to a mistake of the gun-pointer, or a mistake of the fire-control party, or to mistakes of both. Let us recognize also the fact that, although it is interesting and valuable to analyze the two sources of error, yet it really makes no difference, in any one result, whether certain misses were due to the gun-pointer, the fire-control party, or both. If a gun is fired with absolute accuracy during a certain time, but the skill of the fire-control party is such that only .75 of hits are made, the net result is exactly the same as if the fire-control party gave the sight-bar range with absolute accuracy, and the guns were fired with such a degree of skill that only .75 of hits were made. For this reason, no gun-crew or fire-control party itself can justly be given any mark for skill at battle

practice; all that can be done is to give marks for the degree of skill of a gun-crew and fire-control party co-operating.

To analyze the question, however, let us consider the following cases:

1. If two like guns are fired on board the same ship at the same target, and receive their ranges from the same fire-control party, we see that the percentages of hits made is excellent evidence of the relative degrees of skill of the two gun-crews.

2. If two like guns are fired on board different ships, under the same conditions, at targets of the same dimensions, at the same distance, we see that the percentage of hits they make is the best evidence we can get as to the relative degrees of skill of the two gun-crews; because, since we have no means of knowing the relative degrees of skill of the fire-control parties, we have no reason to suppose either party more skillful than the other.

This leads us to see that it would be reasonable to fire like guns at targets placed at the same distance in any competitive battle practice, even if those guns are in different ships; also that it would be unfair to fire them at targets at different distances.

3. If two guns are fired on board the same ship at targets of the same dimensions, at the same distance, and receive their ranges from the two fire-control parties, and one gun has an angle of fall of 6° and the other of 4°, and both gun-crews make an equal number of hits, we know that one gun-crew and its fire-control party must have exercised greater skill than the other gun-crew and its fire-control party.

This case may be divided into two extreme cases.

(a) The gun-crews are equal in skill.

(b) The fire-control parties are equal in skill.

(a) In this case we see at a glance that the fire-control party which gave the sight-bar ranges to the gun with 6° angle of fall must have exercised greater skill than the other party; because their errors in giving the sight-bar ranges must have caused vertical displacements of the projectiles equal to the vertical displacements caused by the errors of the other party; and if the party giving the sight-bar ranges to the gun with the 4° angle of fall caused an average vertical displacement of the projectiles of say 10 feet, then the other party could have made only two-thirds as much error in range, to cause the same vertical displacement. That is, if the two gun-crews are equally skillful, and make an equal num-

ber of hits, they must have been given the same vertical target to fire at; in which case the skill of one fire-control party must have been 50 per cent greater than the skill of the other party; that is, the ratio of the angles of fall of the projectiles.

(b) In this case, we see that the crew firing the gun with 6° angle of fall must have exercised greater skill than the other crew. The mean point of impact of the projectiles of each gun would probably be at or near *C* (Fig. 3—beyond the target or short of it), at the distance given by the fire-control parties which, being equal in skill, make equal errors; so that, if the angles *ACD* and *BCD* represent the angles of fall of their projectiles, *A* and *B* will represent the relative positions of the mean points of impact of their respective projectiles on the vertical target; so that the angles *ACD* and *BCD* will represent closely enough for practical purposes, the *relative* heights of target needed to catch any probable percentage, say between 0 to 50, of the shots from each gun; or, inversely, the percentage of shots of each gun that would be caught by a target of given size, *the target being assumed to subtend as small an angle, of course, as is usual at battle practice, and to catch as small a percentage of shots.*

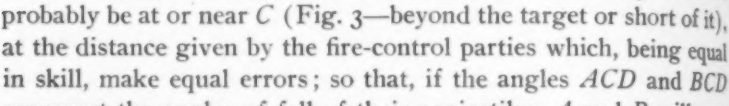

FIG. 3.

In both the subdivisions of Case 3, therefore, it would seem fair to have two guns fire at targets of the same dimensions, at the same distance; but to have the percentage of hits multiplied in each case by some fraction.

In regard to subdivision (a), it seems clear that the score made by the crew of the gun with the larger angle of fall ought to be multiplied by some fraction not greater than 1½ and not less than 1; and that this fraction should be near to 1½ in proportion as the skill of the fire-control party is the important factor.

In the case of subdivision (b) it seems clear that the record

made by the gun-crew with the larger angle of fall, ought to be multiplied by a fraction between unity and 1½, and to be near to 1½ in proportion as the skill of the gun-crew is the important factor.

Supposing the two factors to be equally important, the multiplier would be 1¼, that is, one-half way between unity and the ratio of the angles of fall, in each case.

Although subdivisions (a) and (b) represent extreme cases, the fact that the same rule seems to apply to both, suggests that, even if the competing gun-crews are not exactly equal in skill, or, even if the competing fire-control parties are not exactly equal in skill, we cannot do far from right if, in the case of any two guns, either on board the same ship or on board different ships, we fire them at targets of the same dimensions at the same distance, and multiply the score of the gun with the greater angle of fall, by a fraction half-way between unity and the ratio of the two angles of fall.

The writer respectfully suggests therefore, that all guns in all ships competing for the same prize, fire at targets of the same dimensions at the same distance, the ships steaming at the same speed; and that the percentage of hits of each gun be multiplied by a fraction which is half-way between unity and the fraction of which the numerator is the angle of fall of that gun, and the denominator is the smallest angle of fall among all the guns competing.

Such a plan would seem to avoid all the manifest factors of unfairness, and all the uncertain quantities, that must exist, if firing is done at different distances.

It would seem to have also the advantage that it would give us data as to the relative destructive powers of different ships when at the same distance from the enemy; which is the way in which they will probably be used in battle, drawn up in column parallel to the column of the enemy.

Furthermore it would lead up to what we hope to attempt soon—fleet battle practice.

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THE SUMMARY COURT-MARTIAL—PAST, PRESENT, AND FUTURE.

By LIEUT.-COMMANDER J. P. MORTON, U. S. Navy.

In these days of the strenuous life on board of our naval vessels, when, by virtue of many new conditions, the general trend is toward simplicity and directness, and the desire to abolish all unnecessary "red-tape" is rampant; it is natural that from all sources should come an ever-increasing protest against the elaborate procedure of summary courts-martial, and in fact against the very existence of the court itself. A pretty well crystallized opinion of naval officers seems to be that there should be a "deck-court" or a "one-man court," and within certain limits that court would be undoubtedly a very welcome addition to our system of court-martial procedure. But pending the realization of that happy solution of the problem, let us consider by what means we may reduce to a minimum the work and worry that generally attend the procedure of the court as now established. Already much has been done to reduce the record of proceedings as originally required. By glancing at the pages in "Laucheimer's Forms and Procedure for Naval Courts and Boards," devoted to the summary court, and comparing that form, which was for many years in use, with the one issued by the department on September 20, 1908, it is gratifying to note the exclusion of much that was at one time deemed essential both in the matter of verbiage and of various distinct steps in procedure. Not only has the procedure been boiled down, but efforts have been made still further to smooth the pathway of those who must participate in the sessions of the court, by systematizing the punishments to be awarded; so that, instead of each ship having its own scale of punishments, thereby creating a feeling that one ship

has a severe, and another an easy schedule of fines; and instead of a court debating within itself whether a man shall lose five days' pay or the "limit," the schedule is before them; and both the accused and the court know the amount of money to be forfeited before the court meets, in case the accused is guilty.

This schedule was introduced with two ends in view—that of obtaining an uniformity of punishment for similar offenses, and that of abolishing mitigation. As will be seen, this schedule applies only to loss of pay; and whatever elasticity may exist is only along lines of confinement, in reduction in rating, extra police duties, etc., as provided for by Article 30 of Articles for the Government of the Navy. The loss of pay awarded by the court is cut down by the department to the schedule. If the schedule is followed, except in cases of a disapproval of proceedings and sentence, the sentence as awarded by the court is allowed to stand.

In the adoption of this schedule mitigation of a punishment is now the exception instead of the rule; and it is well understood that the subsequent lessening of a punishment by any reviewing authority carries with it an apparent palliation of the offense, and goes far toward decreasing the conviction in the mind of the accused that the offense was reprehensible or the punishment deserved.

The Revised Form of Procedure.—Under the laws, as they now stand on the statute books, a summary court-martial must prepare a record which contains certain entries—such as the word for word testimony of witnesses, and the various steps of the procedure. This is law. Certain rules that are from time to time laid down for its guidance are issued by the Secretary of the Navy with the approval of the President, and efforts are continually being exerted to cut down the procedure as far as possible and at the same time come within the law. The result is that a form issued on September 20, 1908, has made it possible in simple cases to complete the record on two sheets of ordinary court-martial paper. In many instances these forms are printed, leaving blank only such portions as are necessary to insert the testimony of the witnesses, and other essential data. It is sometimes contended that the new form does not follow the regulations; as, for example, it does not show that the witness was sworn "in the presence of the accused." But, as the accused has been intro-

duced and no fact of his subsequent withdrawal is mentioned (and it is hardly imaginable that a court would proceed with the trial in the absence of the accused), it is to be inferred that the accused was present. This is cited as an example of the fact that protests are sometimes made to maintain the older and more elaborate mode of procedure—zealous efforts, not captious or hair-splitting, but springing from a natural desire to have the proceedings and sentence made so binding as to stand the perusals of reviewing authorities without danger of being disapproved. Attempts have been made to cut down the procedure to the "irreducible minimum" and still maintain its legality; but it is still too long, too laborious, requires too many officers, too many approvals, and too much time to render many sentences operative. We are confronted with this inconsistent state of affairs: a general court-martial tries a man at Manila, we will say, and sentences him to "six months' confinement and the loss of six months' pay." Upon the approval of the commander-in-chief who ordered the court, the sentence goes into effect at once and the loss of pay is final. On the other hand a summary court-martial is ordered by the commanding officer of a ship in Manila Bay, the man is sentenced to, say, "solitary confinement on bread and water for one day, and to lose pay amounting to ten (10) dollars." Upon the approval of the commander-in-chief does this small sentence become operative? Not at all. The record must go to the department to be approved, and two or three months later the final notice of approval reaches Manila, and the ship has probably left, or the man has been transferred, and the checkage follows its weary way from ship to ship until one day, months afterward, it returns to Washington with the tidings that the man has been discharged by reason of the expiration of his enlistment—tired of waiting to hear of the department's action, and the belated fate of his "ten spot."

If the commander-in-chief can approve and render final the sentence of a general court-martial, can he not be entrusted with the sentence of a summary court-martial? Like the Japanese schoolboy, "I require no answer."

As now constituted a summary court-martial requires four officers to sit in solemn conclave and to devote much of their valuable and already much divided time to such offenses as

"smuggling liquor" or "four days over leave." The accused by a recent and heartily acclaimed change in regulation is allowed to plead guilty, as he will in a majority of cases. Previous to this order we had a departure from the established rule of all courts of which the writer has knowledge. The accused had to be tried, the witnesses brought in, from other ships or from ashore if necessary, and their testimony carefully recorded *verbatim et liberatim*, and the long specification proved, down to the very latitude and longitude of the ship, the character of the liquor smuggled, or the clock time of his return. Surely the Supreme Court of the United States could not require more absolute exactness in detail than was required of this body of officers, arrayed in frock coats with side arms, conducting a summary court-martial. Now, if the accused pleads "guilty," no testimony is introduced, and the proceedings are much shortened. But we should go still further in the matter of saving time and work, and try many of these cases by a court composed of one officer.

As now constituted the summary court-martial is one of those solemn farces so well known to all officers. When such a court meets it means perhaps half a day, a day, or many days to be occupied—unless the accused pleads "guilty." If drills are on, they must be suspended; preparations for target practice must wait, for the majesty of a court-martial demands precedence over all other things. Many commanding officers get around this by delaying the orders for the court until there is a lull, and we are treated to long sessions after target practice, on long trips at sea, on field day, and Saturday morning, or when frequently a rest, well deserved for all parties concerned, is spoiled by the court orderly's announcement, "the court will meet in the ward room," and while the mess attendants are trying to clean up for Sunday inspection, and amid the imprecations of departing officers, preparations are made for the laborious procedure. Sometimes, as in the recent operations of the North Atlantic fleet, the cases have been put off until the ships got to sea, as there was no possible opportunity before, and then the cases were slowly ground out in great numbers. Here is the very maximum of delay in a court that, by its very name, is supposed to be summary. The court is not summary, at least, its procedure and the putting into execution of its sentence are not summary; on the contrary, for reasons

given above, it is less summary than any court known to military jurisprudence.

But let us not despair; let us rather hope for better things, for favorable and encouraging support is being given to a proposed scheme that will bring about a real summary court, a one-man "deck-court," and it is believed that the next Congress will enact legislation that will make it possible to try minor cases just as fairly, and far more swiftly and effectively than is now possible. The proposed scheme in substance is as follows:

1. Courts for the trial of enlisted men in the navy and marine corps for minor offenses may be ordered by the commanding officer of a naval vessel, by the commandant of a navy-yard or station, by a commanding officer of marines, or by higher naval authority.

2. Such courts shall be known as "deck-courts" and shall consist of one commissioned officer not below the grade of lieutenant, who, while serving in such capacity shall have power to administer oaths, to hear and determine cases, and to impose, in whole or in part, the punishments prescribed by paragraph 8.

3. Any person in the navy under command of the officer by whose order a deck-court is convened may be detailed to act as recorder thereof.

4. The officer within whose command a deck-court is sitting shall have full power as reviewing authority to remit or mitigate, but not to commute, any sentence imposed by such court; but no sentence of a deck-court shall be carried into effect until it shall have been so approved or mitigated, but upon such approval it shall be final.

5. The court shall be governed in all details of its constitution, powers, and procedure, by such rules and regulations as the Secretary of the Navy, with the approval of the President, may prescribe.

6. The records of the proceedings of the court shall contain such matters only as are necessary to enable the convening authority to act intelligently thereon. Such records, after action thereon by the convening authority, shall be forwarded directly to, and shall be filed in, the office of the Judge-Advocate-General of the Navy.

7. No person who objects thereto shall be brought to trial be-

fore a deck-court. Where such objection is made by the person accused, trial shall be ordered by summary or by general court-martial, as may be appropriate.

8. The court is authorized to impose the punishments prescribed by Article 30 of the Articles for the Government of the Navy, except bad conduct discharge and confinement or forfeiture of pay exceeding 30 days.

The following table shows the punishments that could be awarded by the present summary court-martial, the proposed court, and by the commanding officer respectively:

PUNISHMENTS FOR MINOR OFFENSES IN THE NAVY.

Now authorized for summary courts (composed of 3 officers and recorder).	Proposed for deck courts (composed of 1 officer).	Now authorized for commanding officers.
Bad conduct discharge.	None.	None.
Solitary confinement on on bread and water, not exceeding 30 days.	Same.	Solitary confinement on bread and water, not exceeding 5 days.
Solitary confinement, not exceeding 30 days.	Same.	Solitary confinement, not exceeding 7 days.
Confinement, not exceeding 2 months.	Confinement not exceeding 30 days.	Confinement, not exceeding 10 days, unless longer confinement necessary in case to be tried by court-martial.
Reduction to next inferior rating.	Same.	Reduction of any rating established by himself.
Deprivation of liberty on shore on foreign station.	Same.	Deprivation of liberty on shore.
Extra police duties, and loss of pay not to exceed 3 months, may be added to any of the above.	Same, but loss of pay not to exceed 30 days.	Extra duties.

Paragraph 7 of the above scheme gives to the man a privilege analogous to that in a civil court; *i. e.*, trial by jury instead of by a justice of the peace, and this seems a necessary concession.

A form similar to the one in use in the army is that suggested for use by the new court, as shown below:

PROPOSED FORM OF PROCEDURE FOR DECK-COURTS.

.....

(Surname.) *(Christian Name.)*

.....

(Rank.) *(Ship or Station.)*

RECORD OF DECK-COURT.

Trial of the man named above by court appointed by.....

.....Comd'g U. S. S.....

....., 190..

FORMER SERVICE.

Date of enlistment.	Date of discharge	Character of former discharge.
.....	.....	.....
.....	.....	.....

Date of present enlistment....., 190..

Rate of pay per month.....

Amount due .....

In arrest or confinement under present charges since.....

....., 190..

Dates and serial numbers of previous convictions with sentences within one year preceding commission of offense and during current enlist:

.....

Specification of offense: In that he did .....

.....

.....

WITNESSES:

....

....

....

.....

(Officer Preferring Charges.)

I hereby consent to trial by Deck-Court on these charges.

.....

.....

Respectfully referred to the Deck-Court for trial.

By order of .....

.....

.....

Findings:

Of Specification .....

Sentence .....

Number of previous convictions considered.....

.....

.....

(*Deck-Court.*)

Approved ....., 190..

.....

.....

(*Commanding U. S. S. .....*)

Under the regulations, as modified by a recent executive order, a sentence of bad conduct discharge may be carried into effect by the order of the senior officer present if the accused is serving his first enlistment in the navy. If he has had previous service, the sentence is to be considered in connection with his previous record, and must go to the Bureau of Navigation for that purpose. In case of a marine, the order for the execution of the sentence must come from marine headquarters. This is rendered necessary by the centralized system of accounts maintained by that organization, and cannot at present be changed. We are not in the future, however, to be confronted with the spectacle of a receiving ship or detention prison overcrowded with men, sentenced to bad conduct discharge, waiting, with all the impatience and recklessness naturally born of the situation, for their release to come from the Navy Department.

The remaining important step to be taken,—and legislation will be required to effect it,—is the execution, by the senior officer present for a summary court-martial and by the commanding officer for a deck-court of a sentence involving loss of pay, their approval rendering it final.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

EFFICIENCY AS A BASIS OF ORGANIZATION AND WAGES.

By HARRINGTON EMERSON.

REPRINTED FROM *The Engineering Magazine*, WITH AN INTRODUCTORY NOTE BY PHILIP R. ALGER.

At first sight it will probably seem to many readers of the PROCEEDINGS that the subject-matter of the following article is quite foreign to the purpose for which the Institute was established and in pursuance of which its PROCEEDINGS are published.

It may well be asked what interest the naval officer has in "the basis of wages" and what it boots him to learn that a skilled shoveler can shovel as much material as four average laborers, or that it is possible to raise 1000 bushels of potatoes on an acre of ground from which the average farmer would get but 100 bushels.

Our Constitution sets forth as the object of the Institute "the advancement of professional, literary, and scientific knowledge in the Navy," and the publication of Mr. Emerson's article in our PROCEEDINGS might be fully justified upon the sole ground of its literary merit and its content of scientific facts. But the object of the Institute, in the broadest sense, is to advance the efficiency of the navy, and the real value to the navy of Mr. Emerson's article is the lesson it teaches that in every walk of life, in the navy as well as in the factory, there is room for enormous improvement in efficiency.

We have had in the navy in recent years one striking example of what can be accomplished by intelligent effort. But a few years ago we were content with a rate of fire of one round in three minutes from our heavy guns and with an inaccuracy of aim that would have made the percentage of hits pitiably small had the real hits upon a target been counted. To-day a rate of fire of two rounds a minute has been attained with the same guns, and an accuracy such that almost every shot is a hit. And be it under-

stood that in the main this immense improvement has resulted, not from improved ordnance material, but almost wholly from the greater skill of the personnel.

Still more recently we have seen in the navy an increase of efficiency in the engineering departments of the ships of our battle fleet, resulting in a very considerable addition to its radius of action. And here again the improvement is due to intelligent effort on the part of the personnel, not at all, in this case, to improvements in material.

These two examples, indeed, may well be taken to demonstrate that the inefficiency which Mr. Emerson shows to exist throughout the industrial world exists, at least to some extent, in the navy too; that greater, even very much greater efficiency, of organization, of personnel and of material, is attainable in the navy; and, finally, that efficiency depends much more upon the skill of the workman than upon the perfection of the tool.

I. TYPICAL INEFFICIENCIES AND THEIR SIGNIFICANCE.

Nature's operations are characterized by marvelous efficiency and by lavish prodigality. Man is a child of nature as to prodigality, but not as to efficiency. If it had happened the other way—if he had followed nature's lead as to efficiency, but had taken up parsimony as a distinctly human virtue—the human race would have become wealthy beyond conception.

Most political economists have preached parsimony, not efficiency. As parsimony is not one of nature's teachings and as efficiency is, it would be better to aim at efficiency first and leave parsimony to the generations to follow, who will be forced to make a virtue of necessity.

The efficiency of Nature's operations is seen on every side.

There is Nature's pump, which draws up the water from the surface of the ocean to a vast height, carries it thousands of miles and deposits it on mountain tops and over plains. No reciprocating parts, no valve slip, no lost motion, no frictional resistance, no pipe lines. Prodigal in the amount sucked up, prodigal in the height to which it is lifted, prodigal as to distance transported, but as a pump proposition a perfect heat cycle.

There is Nature's storage battery in muscular reserve. A salmon will enter the Rhine from the sea, cease feeding after entering fresh water; he will swim up stream 500 miles, in exceptional

cases stay at the headwaters for 17 months, and then, not having lost much weight, will swim to sea again.

An oil engine may reach 30 per cent of thermal efficiency, but the salmon, assuming his whole weight to be pure oil, stores at least several hundred per cent more than thermal efficiency.

The salmon uses stored, not thermal, energy.

The fire-fly, the glow-worm, the phosphorescent jelly-fish, show a far higher light efficiency than has ever been reached even by vacuum lamps.

A heavier-than-air flight of 23 miles is the limit thus far attained by man; but most of Nature's visible creatures, from the midge to the heavy swan, revel in mechanical flight. From swans to humming birds, innumerable feathered creatures fly every spring from the tropics to the Arctic circle, every autumn from Arctic circle back to tropics, while some of them fly from Arctic to Antartic.

To attain the high efficiency of stored energy of the fish, the high mechanical efficiency of the bird, the high lighting efficiency of the fire-fly, is not an ethical or financial or social problem, but an engineering problem, and to the engineering profession, rather than to any other, must we look for salvation from our distinctly human ills, so grievously and pathetically great.

Inefficiency, principally of administration, is alone responsible for the long bread line of able-bodied men, which during this winter, spring and summer honors Mr. Fleischman's generosity, but disgraces New York City. Inefficiency, principally of administration, is alone responsible for the 700 starving children, fed daily at the East side schools in New York.

For every mouth that comes into the world, there are two hands, two feet; and, if each set of hands and feet does not have an organizing brain to direct it, there are occasionally great creative and organizing minds, whose province, whether they know it or not, ought to be to enable the hands and feet to forestall bread lines and infant starvation.

When one considers such products of engineering knowledge and skill as a first-class ocean steamer, with its perfection of design, its perfection of machinery, its perfection of line and staff organization; or when one considers a modern New York office building, the Hudson Terminal for instance, where one finds without any futile or inept talk, discussion, or legislation, a harmonious and smooth-working combination and aggregation of in-

tense individualism, intense socialism, intense communism—and even intense anarchy, since all the tenants come and go as they please—one realizes that it is to engineering knowledge and practice one must look for redemption from existing evils. Men, women and children starve, not because there is not abundance and plenty, not because the few have appropriated the portion of the many, but because there is such tremendous waste. The actual and potential wastes in each year amount to as much as the total accumulations of wealth, and if all the possessors of accumulations should be left in undisturbed possession, and the wastes of current production and use be eliminated and equitably apportioned according to meed and deed, no woman or child would have to do mill or factory, store or office work, no old man or woman would have to toil, no young man need delay his marriage, nor any head of a family be torn by anxiety as to the feeding, clothing, or housing of his dependents.

It is distinctly the business of the engineer to lessen waste—wastes of material, wastes of friction, wastes of design, wastes of effort, wastes due to crude organization and administration—in a word, wastes due to inefficiency. The field is the largest and richest into which any worker was ever turned.

Progress—absolute, not temporary time-serving—will be made slowly or rapidly as the ideals and standards are high.

The field is large and rich because so little is being done, because there is so much to do.

Very few, outside of those who have made special investigations, realize how very low the average efficiency of endeavor is, even in a highly civilized country like the United States. Everywhere we see brilliant results; rarely can anyone follow the losses between result and initial supply.

We are all familiar with the light from an electric incandescent film in a bulb. We know that usually the power revealed in the light comes from coal found in mines. The human endeavors, in producing light from coal in the mine, to worker's table, can be followed both absolutely and comparatively.

We can assume the fire-fly to have attained 100 per cent standard; not absolute, but a standard that engineers might expect ultimately to attain. That the fire-fly is 100 times as efficient in combined economy and production is scarcely believable, yet a

rough analysis of fire-fly light and of bulb light from coal will show this to be the case.

A worker requires on his table, for least fatigue and detriment to the eyes, a certain amount of light. As the sun does not always shine, as winter days are short, as some rooms are at the bottom of air shafts, artificial light is needed. Electric light is most convenient and safest. What is the efficiency of production of electric light compared to the efficiency of the fire-fly, which will be called 100 per cent standard?

The fire-fly's source of light is the hydrocarbons contained in what it has eaten. Man's source of light is the hydrocarbons in coal.

The fire-fly finds its food with about the same facility that it finds the oxygen it breathes. Man finds oxygen without expense, but there are enormous wastes between coal in mine and coal entering furnace door. Of coal owned in ground, half the seams are not mined but ruined, and at best 75 per cent is recovered from the seams that are mined. This reduces the mined coal to 37.5 per cent of the total coal destroyed in mining. The workers and machines are inefficient all the way from coal seam, through mining and transportation, to furnace door. This adds unnecessarily to cost. The efficiency of purchase price is only 70 per cent. In furnace, boiler, engine and generator at best only 10 per cent of coal energy appears as electrical energy. The fire-fly's conversion of hydrocarbon into energy is on a basis of 40 per cent. Of the electrical energy only 5 per cent is recovered as luminous energy.

From supply to light emitted the fire-fly shows a continued use, transformation and luminous efficiency of 100 multiplied by 0.40 multiplied by 0.30, equals 12 per cent. Man shows 37.5 multiplied by 0.70 multiplied by 0.10 multiplied by 0.05, equals .13125 per cent, or a little over ⅛ of 1 per cent. The fire-fly is about 100 times as efficient.

The fire-fly effects two further very great economies; it flashes its light only for the time actually needed and it also flashes it for the benefit of eyes made exceedingly sensitive by darkness. These economies we need not consider for ordinary working illumination, although both of them are very effectively used in the theatre and in biograph exhibitions.

Man usually produces ten times as much light as is needed and

wastes 90 per cent of it. The fire-fly producing light with one one-hundredth part of the hydrocarbon used currently by man, gets along with one one-thousandth of the light used by man.

If any human activity is followed out from initial reservoirs to final attainments, a similar sequence of losses will be found—losses gauged not by any ideal of unattainable standard, but by what is being continuously accomplished all around us. Even if, as yet, some of the high efficiencies seen in Nature are beyond reach, it is a greater reason for eliminating those wastes which are avoidable and which are primarily responsible for the starvation of men, women and children.

Not only are occurring wastes more flagrant than is generally admitted, but it is also not realized that very hard and extremely exhausting work is not an evidence of efficiency.

The fire-fly works comfortably; the miner and furnace stoker do not. Recently on the first of the hot summer days, I stood on the charging floor of an iron foundry in the middle West. It was a foundry far-famed for its advanced methods. Three men weary, haggard, worn to the limit of human endurance, were throwing the pig, scrap, and coke into the cupola, yet in spite of their exertions they were working with only 33 per cent efficiency. Three days before we had observed two men, with less fatigue and effort, charge a cupola twice as large. What caused the 67 per cent inefficiency? The tracks for the cars bringing up the supplies of pig, scrap and coke, were so located as to the single cupola door, that three men were required to charge. One lifted a pig from the car, passed it to his companion who swung it to the third man who threw it into the cupola. This had been going on for twenty years. At the other foundry, there were two cupola doors, the car came up so that each man unloaded, with minimum of effort, directly from car into cupola.

That men should work very hard for 9 or 10 hours per day is not a hardship if they are interested in their work, or if, in the larger interest of the community, they work efficiently; but to work desperately hard for many hours at dirty, hot and rough work, yet waste 67 per cent of the time and effort, is unpardonable. What could not have resulted from an elimination of this waste?

1. The product could have been cheapened.

2. The men could have worked one-third the time and have accomplished as much.

3. One man could have done all the work and have earned three times as much.

The benefits should however be distributed in all three directions. Fewer men should work less hard, receive higher wages, and deliver a cheaper product.

The inefficiency on the charging floor pervaded the whole of this foundry although it stands exceedingly high in its class. The proof of the general inefficiency in this foundry is evidenced by the fact that the other foundry turns out its finished castings for less than half as much per 100 pounds, labor, materials and overhead charges included.

It is not because men do not work hard but because they are poorly directed and work under adverse conditions that their efficiency is low.

Railroad repair shops throughout the country do not show 50 per cent efficiency on an average, as regards either materials or labor. When the particular jobs are picked out, similar or worse wastes to those of the charging floor, appear. An actual instance observed was as follows:

The foundry made, for a railroad shop, big cylinder bushings. These, after being machined in the railroad shop, weighed about 375 pounds, but the original casting weighed 1780 pounds. It took three days to remove 1405 pounds of cast iron. It should have taken less than one day if the rough bushing had weighed only 600 pounds.

COMPARISON OF COSTS.

	As made.	Standard.
Weight, rough	1,780	600
Cost per pound	$0.04	$0.04
Total cost	$71.20	$24.00
Labor	3 days	1 day
Cost of labor, $3.00 per day	$9.00	$3.00
Machine charge, $2.00 per day	$6.00	$2.00
Overhead charges, $2.00 per day	$6.00	$2.00
Total cost	$92.20	$31.00

In this same shop the most efficient men were checked up and found to average only 60 per cent of actual output, compared to realizable standards. At the end of two years of persistent effort

many of the best men were brought up to 110 per cent efficiency, but there were still men as low as 10 per cent as to actual output compared to reasonable standard—the same standard on which others realized 110 per cent.

In another big locomotive shop, a careful study of the machines which had been in operation for 20 years showed that the location of 75 per cent of them would have to be changed, so as to facilitate the orderly, effective, and economical progress of work from one to the other. This and other eliminations of wastes doubled the output, with less labor costs.

In consequence of general shop inefficiency and operation inefficiency due to similar causes, locomotive repair costs, on western railroads, run from $0.08 to $0.12 a mile; yet a most efficient superintendent of motive power on a large transcontinental road succeeded in dropping to $0.05 and had only touched the high spots, his well considered opinion being that $0.04 was reasonably attainable. On another transcontinental road, repair costs per mile were dropped from $0.1374 to $0.08 by persistent effort, but when the efforts were relaxed expenses immediately rose to $0.17. They should have come down to $0.06. Eastern and southern roads, with their small engines, better coals, and better waters, are not to imagine that they show any higher efficiency. They are on the whole worse.

It was a leading eastern road that established piece rates in its car shops and then limited the earning power of the men. When there was a sudden demand for increased car repairs, the limit was taken off and the men doubled their earnings. Then the limit was put back. Other eastern roads have also signally failed in attempts to increase the efficiency of their repair shops.

In a leading southern shop many men were receiving 12-hours pay for 3-hours work.

Coal wastes on railroads are almost as bad as labor and material wastes. On a very large railroad system, fuel charged per 1000 tons of train weight per mile averaged 260 pounds; yet actual tests where all coal used was weighed, showed a consumption between terminals of only 80 pounds. This actual consumption could be doubled, be made 160 pounds, yet this standard be only 60 per cent of the actual wasteful expenditure.

The total amount of preventable material and labor wastes and losses in American railroad operation and maintenance approxi-

mates $300,000,000 a year—not less real, but more easily preventable, than the $600,000,000 of fire losses and fire-department expenses, which actually occur in the United States. This inefficiency of effort pervades to a greater or less degree all American activities.

Mr. F. W. Taylor, who has given twenty-five years to the minute and scientific study of inefficiency, and who as an incidental consequence developed high-speed steels, thus speaks of it:

> That the first-class man can do in most cases from two to four times as much as is done on an average, is known to but few and is fully realized by those only who have made a thorough and scientific study of the possibilities of men.
>
> This enormous difference exists in all of the trades and branches of labor investigated, and this covers a large field, as the writer together with several of his friends have been engaged, with more than usual opportunities, for twenty years past, in carefully and systematically studying this subject. It must be distinctly understood that in referring to possibilities, the writer does not mean what a first-class man can do on a spurt or when overexerting himself, but what a good man can keep up for a long term of years without injury to his health, and become happier and thrive under.

Inefficiency similar to that in the manufacturing shops exists in all building operations to the same or even greater extent. Mr. Taylor found a labor efficiency of only 28 per cent in the rough labor employed in the Bethlehem Steel Company's yards. The writer, by time studies, determined an efficiency of only 18 per cent in a gang of laborers excavating a foundation, and even less on some construction work in the erection of the large office buildings in New York.

The United States and State agricultural bureaus have determined similar inefficiencies in farming operations. The land was there, the effort was there; but owing to poor preparation of soil, poor planting, poor cultivation, the net results in such great staples as cotton, wheat, and corn, have been less than half of what proper methods, with the same climatic conditions, land and men, have since realized.

The agricultural stations and Mr. Luther Burbank, combined, have been doing for agriculture what Mr. Taylor and his disciples have been doing for the machine shops.

In our whole educational system there is the same inefficiency. Years are given to study, yet better results have been attained in months. In American schools the two main objects of education,

amenities and discipline, are largely neglected; and instead an immense amount of time is consumed acquiring quantities of information of very low absolute or ultimate value.

Inefficiency is not a local evil. It extends through the whole of American life—extends through the whole industrial life of the world. The Chinese coolie, who as a daily task carries 100 pounds 27 miles for $0.27, is industrious and hardworking, but not more inefficient than the American railroad which moves a freight car an average of 23 miles a day, the cars at best averaging only half loads per mile.

By a very inefficient use of his brain and muscles, the coolie carries the maximum load a maximum distance for a minimum price. The American railroad by the most advanced engineering and industrial methods carries an absurdly small net load for an absurdly small distance at an unnecessarily high cost.

Prevailing inefficiency is not a lapse from former virtue. We cannot praise "the good old times" when everything was done better. The coolie in spite of his many virtues is not better than the railroad whose charges per ton mile average only one-thirtieth those of the coolie. The difference is, however, that elementary though his methods are, the coolie has high standards, evolved during many centuries, but in Europe and America the railroad and the modern shop, using methods of great promise, have as yet no standards.

In tabulating inefficiencies it is not assumed that it is a human ideal to work hard all the time and to spend nothing.

The unit is the man. If he elects and can manage it, he can live in a tub, bask in the sun, and curtail his efforts and wants to a minimum. If he elects, he can work hard for days, weeks or months, and in short and riotous extravagance spend all he has accumulated. The fire-fly probably is chargeable with both extremes, but what is expected is that the man shall emulate the fire-fly in working efficiency when he does work.

Each nation has its own ideals, and the readiness with which the new ideal of efficiency can be assimilated and made effective, will depend on psychological rather than physical and mental traits.

The Japanese can equip their mills with American machinery and work on American materials. If in addition Japanese men are more quick to assimilate or to develop best methods, then indeed will the European and American, in the long run, lose.

II. NATIONAL EFFICIENCIES; THEIR TENDENCIES AND INFLUENCE.

Inefficiency is a form of waste, of loss; it lurks everywhere—in processes, in materials, in individuals and in nations. There is however a difference in kind between the two forms of inefficiency, one manifest in processes and materials and the other manifest in individual or nation. To the efficiency of a process or in the use of a material there is a clearly ascertainable maximum, and when it is exceeded the material gives way, as in the Quebec bridge, but to the efficiency of an individual or of a nation there is no predeterminable limitation. In the passion for modern scientific accuracy it has proved more interesting, and more has been done, to solve the lesser problem of efficiency, in process or material, the larger problem of individual or national efficiency being in fact almost wholly ignored.

Men are quick to catch and appropriate the ideas of other designers as to bicycles, steam engines, gas engines, automobiles, so that the same standard designs and performances occur in widely scattered countries; but individuals and nations differ fundamentally not nearly so much in the degree as in the nature of their characteristics. They differ not as one coal from another, but as sulphur, carbon, hydrogen and radium differ. The analogy of fuels is illuminating and may further a better understanding of the whole question of efficiencies. If a coal yields 13,000 B. t. u. the combustion problem is to utilize as large a percentage of them as possible. Other elements in combination with oxygen may evolve only 4000 B. t. u. per pound, as sulphur, or 60,000 as hydrogen; or radium, without troubling to combine with oxygen, will evolve per pound 210,000,000,000 B. t. u. or thereabouts.

It is the province of the chemist to determine the actual number of heat units in any element or combination, so that we have, for each, a theoretical maximum. It is the task of the combustion engineer to devise apparatus which will utilize the largest percentage of the heat units in the fuel; but the more difficult problem of the economic engineer is to select the fuel and burn it so as to secure the desired result at lowest cost.

It is more difficult to select intelligently the power installation for a tug boat, between the limits of a drift-wood burning furnace and a Diesel crude-oil motor, than it is to design and secure good furnaces, good boilers, or good engines. A very elementary fur-

nace and boiler will yield 50 per cent efficiency; the best boiler and furnace, and then only under exceptional test conditions, may yield as much as 85 per cent; and no increase of expenditure, no increase of designing skill, will realize 90 per cent. When, however, one passes from sulphur to carbon, from carbon to hydrogen, from hydrogen to radium, the progession is not one of 80 per cent improvement between best and poorest, but the best, radium, is fifty million times better than the poorest, sulphur.

Applying the analogy of fuels to individuals and nations we have as yet no analysis of humanity which will enable any one to determine their capabilities. We do know how the best individual will react against some definite mechanical proposition; we do know the best record as to running or swimming or any other athletic or manual performance, with the certainty that it will never be appreciably bettered; but even this knowledge has as yet been utilized to very small extent, outside of sport, to increase individual efficiency in a particular task. Our manipulators of human material are constantly using human radium on a grate intended for lignite coal, very much as the early engineers in the natural-gas fields used natural gas expansively to drive engines originally built for steam.

The difference between sulphur and radium as evolvers of heat is fully paralleled in the difference between the Italian immigrant (who, with wheel-barrow, works at less than 20 per cent efficiency on the railroad dump), and the Corsican, of poverty-stricken antecedents, who in early manhood pushed the whole of Western Europe and also the two Americas a hundred years forwards. It is not assumed that every immigrant boy is an embryo Napoleon; but from John Jacob Astor on, foreign immigrants who would have remained peasants in their own country, have become dynamic forces in the New World, simply because, to these radium individuals, opportunity occurred.

As to any man, and as to any nation, the as yet unsolved problems of efficiency are: (1), to enable each to accomplish the uttermost in reaction with the task set, average present efficiencies being about 60 per cent; and (2), to set each at the highest task of which it is capable, present average efficiencies being so much below one per cent of the best as not to warrant an estimate.

The differences between coal and coal are molecular; the differences between sulphur and radium are atomic. The differences

between the speed of one runner and another, the natural resources of one nation and another, are physical; the difference between the spirit of Diogenes and the spirit of Napoleon, between the spirit of the Papuan and the spirit of the American, are psychical.

Inherited wealth and inherited power have rarely made men great, although when young heirs first come into their inheritance they may for a short time dazzle by their prodigality. Great natural resources will not in the long run maintain nations, although during the period of reckless squandering they may seem prosperous to themselves and to others. For the past 10,000 years Central Africa has teemed with natural resources, but it was the Vikings of bleak Norway who conquered the European and Mediterranean littoral, incidentally also taking possession of Iceland, Greenland, and probably visiting the northeast coast of America.

Alaska is a better country than Norway or Switzerland. It has 100,000 square miles of agricultural land, the best coal in North America, lead, copper, silver and gold mines, vast forests, rich fisheries, a great fur trade, and 10,000 miles of ice-free sea coast, harbor-indented, along the great Pacific highway between all Asiatic and all North American ports. The Eskimo, Aleuts, Indians, and mongrels of Alaska, surrounded by unparalleled natural resources, have accomplished little, although their supineness has been no greater drawback than the stupendous ignorance, neglect, and corruption to which this empire of the future (if men are forthcoming) has been subjected by some of the departments at Washington. The Swiss, for whom nature has done so little, have, individually and nationally, developed high efficiency. When Alaska, the relatively richer country of the two, has as many inhabitants as Switzerland in proportion to its area, it will be a nation of 120,000,000. No wonder the Canadians, with nearly six times the area of Alaska, have hopes of repeating in America the polar drift of empire so manifest in Europe, Asia, Africa, and South America.

Between one civilized country and another there are extremes of variation in natural resources, yet all are prospering. The efficiency of the workers in all of them is low, yet each country is growing rapidly in wealth. The cause of prosperity cannot lie in natural resources, since some of the countries with the most resources are most backward and others with the poorest resources

are most forward. The cause of prosperity cannot lie in the ability or fidelity of the workers, since all of them, when checked up, are found to be of low average efficiency. The cause of success must therefore lie either in some common trait which all possess or in the exploitation of some different trait in each. The only common trait is ambition, the desire for success and wealth; but the gratification of ambition, the attainment of material success, has each time been due to a different psychical instinct. In Alaska the eagle, the seal, and the bear all grow fat by feeding on salmon. The food is common to all three, but the method of appropriation is different. The eagle descends from the air, and lifts the salmon out of the sea, the seal pursues and seizes the salmon in the water of the sea, and the bear scoops him out with his paw when he finds him in the shallow brooks. The British, French, Germans, hunt success along lines as different as those of the eagle, seal, and bear. It is easier to describe the physical differences between eagle, seal and bear than to describe the psychical differences between the great industrial nations. Nevertheless the differences exist, and the causes of the respective successes cannot be understood unless the reaction of success of these psychical traits is understood; and, what is more important, that nation will in the long run reach a higher level which is able not only to appropriate the best designs and processes of its rivals but, what is immeasurably more important, to appropriate also and possibly to improve their psychical inspirations.

The English, the French, the Germans, the Japanese, the Americans, are not great because they all have schools and sea ports and coal, but because schools and sea ports and coal mines have fed wholly different natural characteristics. To discover these different national characteristics it is necessary to back off, both in space and time, so as to lose details and see only the governing traits. No nation can be reduced to a formula, but an attempt will be made to separate out, for a number of leading industrial nations, traits of which they more or less seem to possess a monopoly, and which for that very reason merit careful analysis by their rivals.

In recent centuries Great Britain has been easily the leader both commercially and industrially. The English also were up and doing before daybreak in other directions, and by the time the other nations woke up, either yawningly or to the sound of some

revolutionary alarum, the English were anywhere from several decades to several centuries on their way. They limited the power of kings, 1215 A. D.; they abolished divine right in 1649, and selected by vote their own sovereign in 1689. The American colonists woke up in 1776, the French in 1789, the Germans in 1871. During the period when other nations were pulling each other down in continental Europe, the English were appropriating large parts of Asia, America, and Africa as well as the continental islands. When other nations were using wood and developing charcoal burners, the British were opening coal mines. When other nations were building post roads, the British were stringing iron rails; when the Americans were building the best and fastest wooden clipper sailing ships, the British were not only building iron steamers, but they were also calmly taking possession of all the strategic points of the seven seas. While other nations were stretching wires on poles along railroad rights of way within their own boundaries, the British were enmeshing the globe with submarine cables. It is not because the British are the greatest shipbuilders that they control the sea, but they incidentally build ships and a few other things because at least 100 years before any one else realized its importance, they made the unclaimed empire of salt water their own. For any other power at this late date to aspire to rivalry on the sea is futile—is laughable.

Consider the North Sea. Sweden, Russia, Germany, Holland and Belgium, all the immense maritime trade of Northern Europe, goes to and comes from the Atlantic Ocean and all there is beyond, through what the English proudly call the English Channel, with the cliffs of Dover at one end and on one side and the Channel Islands at the other end and on the other side. Consider the Mediterranean, bottled up at one end at Gibraltar and at the other by the French-conceived, designed, and dug, but at present English-owned Suez Canal, with Malta conveniently and centrally located in the waist, with Cyprus watching the egress from the Black Sea of both Turk and Russ. The only nation in Europe who can go to sea without British consent are the Norwegians, the French, the Spanish and the Portugese. Consider the Atlantic Ocean, north and south, studded with British mainland ports and island outposts along all its four sides, and up and down through the middle. Consider the Indian Ocean—Cape Colony at the western southern end, Australia at the eastern southern end, the western

northern entrance blocked at Aden, the eastern northern entrance blocked at Singapore, with Mauritius, Ceylon and sundry other islands scattered centrally around, very useful for all sorts of purposes, coaling and repair stations, landings for submarine cables, shores for space telegraph installations. Consider the Pacific Ocean—not quite so completely a British sea, but nevertheless even in it they would be first in length of sea coast were it not for Alaska's indented mainland and islands. Although second, as to mere length of shore line, they have, both on American and Asiatic side, strategically a greater number of important posts, not counting Australia and New Zealand to the South, than any other power, and when the all-British cable was laid from Vancouver to Australia and New Zealand, as many British Islands as were needed turned up conveniently for mid-ocean stations.

Not content with commanding the European Mediterranean, they also command the American Mediterranean, with the counterpart of the Suez Canal in the St. Lawrence River, the deep-water channel between the Great Lakes and the Atlantic. They also control one side of the water passage from Lake Superior to Lake Huron, from Lake Huron to Lake Erie, from Lake Erie to Lake Ontario. On the Pacific side of North America it is the same. There is another though smaller inland sea there, the matchless Puget Sound, but, in spite of 49 degrees north, the treaty boundary line, they not only reserved their own independent sea outlet, north of Vaucouver Island, but they established another Gibraltar at Esquimalt, on the north side of the Fuca Straits, only entrance to the largest and most important American harbor on the west coast.

Although the United States at last controls Panama, during the whole of the last century it was not any American statesman who foresaw the importance of this control, nor was it any American ambition that dared attempt the task of breaking the Isthmus.

Two hundred years ago the British appropriated a complete chain of islands cutting off both Gulf of Mexico and Caribbean Sea from the Atlantic Ocean; in 1827 Goethe, in a masterly discussion of the importance of the Isthmian Canal said: "I would be surprised, if the United States would miss the chance to get such a work into her own hands. It is entirely indispensable for the United States to make the passage to the Pacific Ocean, and I am certain that she will accomplish it." It was, however, not the near-by United States that first undertook the work, but the distant French.

So early and so persistent was the British instinct of sea control that surprise is caused, not that the British have so much, but that they let so much of value slip through their fingers.

By right of exploration they might have taken possession of the whole of equatorial Africa; they might, without any one making protest, have annexed both sides of the Straits of Magellan; they might have seized on both the Diomede Islands in the middle of Bering Straits; and it is incredible that after discovering the Hawaiian Islands they should have let them go.

For the British these islands have strategic location and value as the only direct sea route on which they are situated is the one between Vancouver and New Zealand. They are of no value strategically to the United States, as they lie at least 1000 miles south of any direct route from the United States to Asia, lie 1000 miles out of the course of steamers making the run from Panama to Singapore, and the attempt to magnify them as an important sea possession of the United States merely accentuates the difference between the deep, set purpose of the English and a fatuous impulse.

So sensitive are the British as to anything that appertains to the control of the sea that they get into a panic at the mere suggestion of tunneling the English Channel, and when the Germans built the fastest steamers for the Atlantic trade the English did not rest until they had evolved a new form of steam engine, a new form of screw propeller, had built larger boats than any other flag possessed, and with the combination, regained the lost blue ribbon of the sea. Similarly, as soon as the French, Germans, Americans laid a few straggling sub-oceanic cables, the British at once set up space telegraph stations so that soon no British steamer anywhere need be beyond call from British land.

This persistent far-sight, this stubborn holding onto an idea, characterizes the British bull-dog in all things, although illustrated above only as to sea power; and it is perhaps well for the rest of the world that on the whole he is good-natured and that he does not have too many ideas.

The predominant characteristics of the French are quite different; none the less admirable—in fact, more progressive. The French are brilliant innovators and as a nation they think logically and execute artistically. Their revolution had its inception in the work of the encyclopedists, and its culmination in the Code Napo-

leon. In the Théatre Français the prices of the seats are cut into the solid marble, but the monogram of the government is detachable, because forms of government are the accident of the moment but the principles of art are eternal. The English follow up persistently a few all-important matters. The French evolve brilliantly many entirely new things. The French invented and made practical the bicycle, the French were the first to ascend into the air in balloons, and France still holds all the official records for all sorts of flight—distance, dirigible, heavier than air. The French started both the gas engine and the automobile; they first used rapid-fire machine guns, the mitrailleuse; their passenger locomotives make the fastest regular runs in the world; they developed compound locomotives, and also, the most powerful freight locomotive, the Mallet articulated, is of French design. To the French we owe the first successful submarines; to a Frenchman, Daguerre, we owe photography, and to another, pyrometry, which has placed metallurgy on a scientific basis. The French invented and put into effect the decimal system, which has been universally adopted for money (except by the insular British) and the French also established and maintained bi-metallism, without a hitch, for 70 years, although in that period the greatest fluctuations that the world has ever experienced occurred in the relative production of gold and silver. The French have always been bright enough to avoid the financial panics that have disgraced Great Britain, Germany, and the United States. The French dug the Suez Canal and also started the works at Panama. Most appropriately, we owe to the French modern stearine candles, the Argand burner, and the brilliant use of the electric current for light. Storage batteries of both types were discovered in France, as also plate glass, rolled glass, and wire glass. A Frenchman first deciphered the hieroglyphics of Egypt; another Frenchman, Pasteur, expanded and made rational the practice of inoculation; another one, Berthelot, developed modern chemistry, and to the French we owe artificial silk.

It was because the French teem with revolutionary ideas that Franklin's ability received from them more immediate and cordial recognition than from either Americans or from British.

The characteristic trait of the French is brilliant innovation carried out in an orderly, logical and artistic manner.

Germany is one of the world's greatest industrial powers—so

menacing, in fact, that the eyes of the industrial and commercial world are turned apprehensively in her direction. Until recently, however, she has always been bringing up the rear, the slow but sure turtle among the nations. When France, Spain, and England were parts of the Roman Empire, assimilating Roman civilization, Germany was a storm center of savage ferment. Italy officially adopted Christianity in the fourth century, France became Christian in the fifth century, but it was not until the ninth century that Charlemagne gave the Saxons their baptism of blood. When the French and English were evolving parliaments and courtly manners, the Germans were engaged in their thirty-years war. It is characteristic that the renascence in Italy and France took the form of a revival of classic art, literature, and culture; in Spain and England took the form of oversea adventure; but in Germany the form of religious revival and reform. It is also not less characteristic that while other nations have made progress through revolution and violence, the Germans are rapidly overtaking them through peaceful evolution.

American wooden clipper vessels were the queens of the sea from 1800 until the introduction of steam. Previous to 1870 the only German ship-building was in the Baltic yards where American models were imitated, but shortly after 1870 Germany "resolved" to build ocean steamers and in 25 years her ocean liners, German designed, German built, German manned and officered, were the fastest and finest vessels afloat. It required extraordinary effort on the part of the English to regain the lead. America built more locomotives and owned more miles of railroad, many times over, than Germany, but in this year of grace 1908 it is the German principle of superheating that is being applied to American locomotives.

Germany succumbed helplessly before the genius of Napoleon in 1806, but less than two generations later von Moltke had remodeled the oldest of all organizations—military—by adding to line organization the principle of developed staff organization, and it is staff organization that has made Germany during the last 40 years easily the pre-eminent military power in the world.

An English authority on iron and steel has recently shown that in spite of adverse natural and economic conditions which make the average production cost of German pig iron 50 per cent higher than the average cost of British warrants, yet owing solely to

better organization and more advanced industrial discipline, German exports of iron and steel increased 350 per cent in the decade from 1897 to 1906-7, while the British increase in the same period was only 10 per cent.

This habit of the Germans of "resolving" that they will accomplish certain results, and then forthwith succeeding, is exceedingly disconcerting to commercial and industrial rivals. Whether the subject be military organization, the designing of ocean steamers or of locomotives, technical or industrial training, industrial and commercial expansion, all the German needs to do is to desire to surpass and he succeeds, not by far-sighted annexation of a field not yet taken, not by brilliant creation of a new field, but by patient improvement on the model supplied. "Billig und schlecht!" said Professor Reuleaux of the German exhibits at the Centennial in 1876; "made in Germany," the legislative badge of inferiority in 1880; but to-day German products are no longer "billig und schlecht" and, in many lines "made in Germany" is a label of highest excellence.

It is fortunate for their rivals that German efforts are so often indiscriminate, that they will elaborate mathematically the theory of the Dutch windmill and overlook the sirocco blower, that they perfect staff organization in the army and that they have failed to apply it to their shops, being in this respect far behind the best American developments!

Americans have little of the persistence of the English, little of the brilliancy of the French, and not any of the patient science of the Germans. The immigrants or adventurers who of their own choice, full of faith and hope, come to the land of sunshine and opportunity, were the restless daring spirits of all the nations of Europe; first the Spaniards, then the French, later the English, and more recently the Irish, the Germans, the Russians and the Italians. For all these the past held but light ties; they came to stay, and the little they did bring of mental or material equipment proved of scant value. There has been in all of them, of whatever decade or nationality, the common restlessness, the common eagerness to make good. Before them stretched out the promised land, forest and plains, farms and urban sites, transportation monopolies, minerals. The gold-seeker in California, equipped with elementary courage and pick and shovel, exhausting the shallow placers, and spending the proceeds in individual aggrandizement;

such is the true type of the American, whether he be named Astor or Vanderbilt, Rockefeller or Morgan, Jas. J. Hill or Harriman, Carnegie or Guggenheim. Because there were no traditions to hamper, because those prospered most who acted most energetically, American enterprises have been characterized by spasmodic and disconnected impulses, very different from the dogged pluck of the English or the logical development of the French or the studied results of the Germans. In America personality has been everything—personality inbred until often in one generation it became sterile from lack of cross fertilization. Because of different personality, not because of different problems or different opportunity, the New York Central and the Pennsylvania Railroads have grown and prospered, but the Erie Railroad, between the same terminals, has always been in difficulties; and because of varying personality, far more than varying conditions, such railroads as the Union Pacific, the Northern Pacific, have swung up and down and then up again between extremes of inflation and depression. Not in religion, politics, transportation, commerce or industry is there either persistence or clear thought or profound preparation.

An agent of Lloyd's visiting the Atlantic Coast ship yards of the United States reported that American materials were fully as cheap as English materials, that American wages were no higher than British wages, but that the very greatly increased cost of American-built ships was due wholly to the enormous inefficiency of organization and performance. Yet, when the mood takes the American, creations more stupendous, more beautiful than the world had ever dreamed of, suddenly spring from nothing, as in the filmy beauty and sublimity of the World's Fair grounds and buildings at Chicago, but as suddenly these creations fade back in to nothingness, leaving only a memory.

The American, whether at Chicago in 1903, or on the Alaskan White Pass in 1899, crowds the progress of 2000 years into a single year; but to mark the milestones of time, he leaves no pyramids nor cathedrals, nor palaces nor anything else that holds out a promise of secular endurance. Individuality has been supreme, it has accomplished so much. There have been great inventors—Edison, Westinghouse, F. W. Taylor—but what they have created has rapidly become the property of all mankind. When lavish opportunity no longer exists, when invention becomes less the in-

spiration of the moment and more the result of patient research, how then will it fare with the American in the cosmopolitan struggle for first place?

Latest of the civilized nations are the Japanese. The occidental world was opened to them by Perry in 1853 and as late as 1867 they were still using bows and arrows, two-handed swords and chain armor. The Germans and the Japanese (not counting oriental Europe) emerged latest from feudalism and rose into world prominence about the same date, and for that reason both have proved dangerous, because both were compelled to absorb so much from others, and yet were able to supplement it with their own special virtues. The Japanese, with an open-mindedness unparalleled in the history of the world, sent forth their brightest young men to England, to France, to Germany, to the United States; they adopted eclectically all that was best, adapted to their own needs what they had selected, and soon they became adepts. They have sat at the feet of the English in all matters appertaining to the sea, from ship yards to ship officers, from ship models to ship insurance; they have sat at the feet of the Germans in all matters appertaining to military organization, and, as the expedition to Pekin and the Russian war showed, improved on their models; they are as logical as the French and more progressive than the Americans.

Ascribing to the English the efficiency of wise anticipation and continuous persistence, to the French the efficiency due to their innovations of supreme value and merit, the efficiency of the Germans to their perfection of organization, discipline and scientific minuteness, to the Japanese the efficiency due to open-mindedness and marvelous power of assimilation, to the Americans the efficiency due to individuality—it cannot be doubted that it would be more desirable and produce better results to endow a nation of individuals with persistence, clear habits of thought, scientific patience and open-mindedness, than to let loose intense individuality among the English, French, Germans and Japanese. The trouble with the American is that as yet he is provincial, skeptical as to the value of anything outside his own limited experience, a trait perhaps amusingly illustrated in the way he takes for granted that millions of foreigners shall cheerfully give up their allegiance for the sake of American citizenship, but is indignantly surprised when any American seeks naturalization in Europe.

The boundless natural resources of America are being ex-

hausted. Will the American forever be able to maintain a lead through intense individuality alone, or will he industrially as a nation recede before the German, even as native American names have disappeared from Broadway, New York, and been replaced by miles of German names? Will mere resourcefulness suffice in the future? Because he is resourceful, because he is adaptable, because he has always delighted to force the game to the uttermost, it may be that all he needs is a set of higher standards, and that if they are supplied he will realize them sooner than any competitor.

Standards except as to a few performances are as yet undetermined in the industrial world. If the American sets them high, he may attain them, and the prevalent democracy may make it easier for each worker to rise to the limit of his capacity.

III. THE STRENGTH AND WEAKNESS OF EXISTING SYSTEMS OF ORGANIZATION.

It is notorious that great aggregations of wealth and power usually do not operate as efficiently as smaller concerns. The various operations of a railroad or of a manufacturing concern are performed far less economically and efficiently than similar operations in smaller and more compact industrial organizations. Also nothing is so gigantically inefficient in view of its power and opportunities as such an organization as the United States Government. In what it does, it cannot compare relatively with the comfort, security and hygienic conditions supplied by a large, modern American office building.

The ten-million-dollar and upwards company ought to be able to supplement every dollar-a-day worker with a $200,000 a year staff of assistants, thereby making the worker four times as effective and gaining a crushing advantage over the smaller concern which cannot afford the same aggregation of specialized knowledge. The great concerns, however, have conspicuously failed to develop this advantage even if they do have a large staff of experts, a very different thing from a staff organization which gives the least worker the needed direction, stimulus and advice. A $200,000 staff for a dollar-a-day man is neither utopian nor expensive. On the contrary it is to the highest degree economical, if almost infinitesimal attention from a very high priced man will

make, as to his specialty, one thousand or twenty thousand low-priced men four times as effective.

To preserve the adult individual, nature uses staff organization; to preserve the race, nature uses line organization. Both are necessary and they may operate separately, they may alternate, they may work in parallel; but always and everywhere it is one or the other or a blending of both. Man, the individual, is fitted out with a number of aids, each far superior to him, each knowing what to do and how to do it, knowing how to respond to his every call to the extent of its ability. His lungs, his heart, his stomach, his nervous system, how instantaneously they come to his rescue in an emergency! On the other hand a father is succeeded in time by his son, one generation gives way to another, "the king is dead, long live the king!" This is line organization.

The strength of line organization lies in its indestructibility. A company cannot be destroyed as long as two men are left. The captain is succeeded by the lieutenant, and if this one falls, a petty officer takes command. There is always some one in authority. The weakness of line organization is that no one man knows much more than any other, that promotion is by seniority and not by merit. If a company loses its way in the woods it is all lost together. The captain has no special knowledge to meet the emergency. The weakness of staff organization is that if one member of the staff collapses, the whole organization goes to pieces, as when the heart stops beating or the lungs fail to find air. The strength of staff organization lies in its ability to multiply many fold the effectiveness of other staff members, all co-operating to make possible such a wonderful thing as a man, a humming bird, a midge or a yellow-fever microbe.

Organization may be conscious or unconscious. The authority in charge, whether individual or intangible, whether one or many, may know how to do the work or may not know how to do it. In the first case performance may be delegated to subordinates; in the second case it must be, if the work is to be well done, the actual worker, as far as the work is concerned, being a subordinated superior. The most perfectly organized entity in the universe is the living thing. There is an unconscious, unseen authority over it, not in the theological sense, but in the instincts with which it is endowed.

Passing from the single body to a community or family, we

find similar organization, a central authority supported and supplemented by special staffs. Isms fail—individualism, communism, socialism, despotism—not because there is not serviceable value in each, but because form of organization counts for more than theoretical ism, and the highest organization relies on and utilizes all. Institutions have evolved from the primitive family and tribal life of birds and mammals, and birds and mammals, notably man, have evolved, molded by forms of organization.

There is always line and staff in organic nature. Line organization developed in its specially human form not in the family or tribe, but when men gathered in bands, generally for mischief or damage either to animals or to others of their own kind. The experienced hunter led a band on a hunting expedition or the fisher led a company to fish. As the hunters developed into marauders, as the fishermen developed into buccaneers there was pure line organization and very little, if any, staff. The hunter and war captain had himself been hunter and warrior, the captain of the boat had been fisher and fighter. Because he was older and stronger or more experienced he commanded other men, none of whom knew more than he did. When the medicine man or priest accepted a disciple there was even less chance for staff, since the adept knew far more than the neophtyte. Thus all through the development of army, or navy, or church, we find line organization, whose unit is the company, headed by a captain. This kind of organization is at the opposite extreme from pure staff organization found in the living body, and it is also distinct from the mixed line and staff found in primitive family life. The shops and schools adopted line organization almost without modification. There was indeed subdivision of labor, since all foremen did not direct similar activities nor all teachers teach the same branches, but these differentiations were not into staff functions.

Some modern organizations of tremendous strength are those in which staff alternates with line, as in a base-ball team. The ins play in line organization, all subject to the captain, each passing through exactly the same round, since a part of the play, as to its entirety, is handled by each. The outs, also subject to the captain, play distinctly in staff organization, the pitcher, singly, doing all the pitching against each of the ins; the catcher, singly, doing all the catching against each of the ins. The whole inning is played by each. It is because the staff specialists, the pitcher, the

catcher, etc., are superior to the average skill of the ins and combine against each one separately that in the best games there is no score.

In all organizations line and staff have their place. Organization has always been a means to an end, and it has therefore always been an evolution rather than a creation, generally lagging behind requirements. Long after the time when staff should have come to the rescue of line, line traditions and line prejudices have continued to prevail, each line officer trying to create a staff of his own. In the navy a strong staff has by a process of compulsion been added to the line. Supreme as he was, no sea captain quite dared to claim that he knew all about furnaces and boilers, engines and propellers, refrigerating and illuminating accessories, so there have been developed in marine organization very strong staffs. There was not the same compulsion in the army. It is von Moltke's greatest claim to fame that he perceived the deficiency of line organization in the army and supplemented it with the general staff, which made the Prussian army the marvelously supreme organization it became shortly after 1860. The theory of a general staff is that each topic that may be of use to an army shall be studied to perfection by a separate specialist and that the combined wisdom of these specialists shall emanate from a supreme staff. The specialist knows more about his one subject than all the rest of the army put together, but the whole army is to profit by his knowledge. One man may be the authority on military maps, another on balloons, another on roads and road making, another on sanitation, another on explosives or rapid-fire guns, an ever-widening list. Nothing is to be left to chance, or to individual ignorance or brilliancy. The North Germans were not more courageous, not better individual fighters than the South Germans, the Austrians, the Hungarians or the French. Napoleon in 1806 had had no difficulty in defeating the military organization of Prussia, inherited from Frederick the Great, and it took nearly ten years of European coalition, all of Russia, all of Austria, all of Germany, all of Great Britain, to overthrow the French. The Prussian army in the decade 1860-70 became what it was, not on account of men or arms, but through the supreme genius of one man whose creation, the general staff, used the line organization as one of the means or implements to the all-important end. If a man has special military aptitudes, special genius, the staff is the

place for its opportunity and development. In the line special genius only makes trouble. Grant deprived General Butler of his command because Butler did not know how to obey. Nominally, under von Moltke's plan, the line remained supreme, the highest command being vested in the King of Prussia, though he was merely the spokesman for staff plans, even as in England the monarchical line is supreme with its personal staff of earl marshals, etc., yet all the real power lies with the cabinet, a staff organization. It was owing to staff knowledge and staff plans that in 1866, the Prussian army, two weeks after the outbreak of hostilities, overthrew the combined armies of Austria and of South Germany. It was owing to staff organization that the united German army of 1870 decided the war against France, declared July 14, at Sedan on September 2. The French plans for mobilization required 19 days but von Moltke's plan for German mobilization required 18 days, and it was strictly carried out in neither more nor less days than the 18. The French mobilization took 21 days and this delay placed the seat of war in France instead of along the frontier or in Germany. French officers were not even provided with maps of French territory. The French plan of campaign failed before it was even tried, because of the fatal three-days' delay. On August 6, only 23 days after the outbreak of hostilities, one of the bloodiest battles of the war occurred.

Napoleon I was a marvelous genius, but, working through line organization against line organization, he had to get rid of all his rivals, make himself ruler, dictator, emperor, before he could carry out his plans. Von Moltke left the line undisturbed, gathered his eminent military contemporaries into the general staff with him, and through the staff gave his king, the head of the line, an organization before which all the military power of Europe crumbled. It was King William's great merit that he had the good sense to listen to the staff advice of such specialists as von Moltke for war, Bismarck for diplomacy. The Japanese, seeking the best there was in western organization, adopted and perfected in their army the Prussian staff system. At the relief of Pekin they proved themselves in all staff matters superior to any of the allies, the Germans included. Their maps, their Red Cross, their commissariat, their discipline, their humanity were all better. Before and during the war with Russia it was Japanese staff knowledge and

staff skill even more than the high ideals and bravery of the individual soldiers and sailors that brought about the final victory.

Yet even von Moltke's marvelous combination of old line and modern staff could not be adapted without change to railroad or manufacturing activities. Its deficiency lies in the fact that the members of the line, who are many, are excluded from intimate relations with the staff, which is numerically so weak. When the line is supreme there is a great deficiency of special knowledge. When the staff is supreme there is a great deficiency of personal fructifying experience. In last analysis the man in the line, the man down at the bottom of the line, meets the difficulties, and he is the one who most needs staff assistance for his special case. He is the one who should be able to call on the very highest special talent to solve his $0.10 difficulty. He finds this assistance outside of his daily work far more than within its limits. If, for instance, in New York city he wishes to transport himself from the north end of the city to the south end, he offers a five-cent piece and finds at his disposal a fifty-million-dollar subway. In his daily work, however, there is no assistance. For his bread and butter task, which alone makes him of value to others, there is no assistance of this kind.

What is needed in organization is complete parallelism between line and staff, so that every member of the line can at any time have the benefit of staff knowledge and staff assistance. This kind of organization does not exist in perfected form to-day. Modern organizations are defective because they individualize instead of generalize their staffs. The president of a railroad or of a manufacturing plant apportions duties among several vice-presidents, each one of whom takes up a line of duties. This is necessary, but in the old days in the palace of Pharaoh it is not stated that the chief butler organized a staff with a head baker or that the chief baker organized a staff with a head butler. Each vice-president of course requires a staff of his own for his special line of duties, but there are general needs which are the very fundamentals of strong organization and these needs should be under general staff officers, all of whose aggregated wisdom should be available to guide, not only the president and the vice-presidents, but also each subordinate official down to the lowest man in the line. Because there is no general staff of this kind each official down to the worker attempts, more or less awkwardly, to create his own gen-

eral, as well as his particular, staff. There is specialization of line activity, which is always advantageous, but there is also multiplicity of different kinds of general control, which is wholly bad. Imagine an army to which each soldier came with his own individual rifle and ammunition and kit, in which each captain had his own system of tactics, in which each general had his own special plan of campaign! Yet this is virtually the condition of railroad and manufacturing-plant organization to-day. Much of the time and energy of each official is taken up with keeping in order and adjusting to the whole his unregulated staff activities and eccentricities. One of the defects of this kind of organization is that the staffs of the different officials are not correlated. It makes no difference whether the head of a company is an individual or a commission, the organization is that of the line, the old military line, which at best has progressed as far as monarchy with a monarch's staff.

With full understanding of the strength of line organization, of staff organization, and of their mutual advantage to each other, and with a general comprehension of what both have accomplished in the past, it becomes possible to devise and outline a modern line and staff organization suited to the largest industrial concerns. The task would be hopeless if it were necessary to displace or even to modify existing line organization, since scarcely anything is as tenacious of life as institutions. But happily this is not necessary. Von Moltke added staff to line without a jar. A perfect staff could be added to modern line and be self-supporting from its inception without a jar.

A modern company, whether railroad or industrial, is organized for a specific purpose which is secured by an interplay of men, machines, materials and methods. The specific purpose is the end in view, but the interplay is the all important means. Whatever the vice-president's department, he has men, equipment, supplies and conditions to deal with. Whatever the manager's duties, he also has men, equipment, materials and conditions to adjust to one another. Whatever the superintendent's duties he also is confronted with the same general problems as to men, machines or locomotives, materials and methods. The foreman meets the same problems of men, materials, machines and methods, and even the individual worker has also his problems of man, of machine, of materials and of methods. It is evident that the most philosophic

way to meet general and universal problems is by general and universal solution. That is the solution offered by Nature. We have hands, feet, a head and various other bodily parts, each doing various work, but there is only one heart, one set of lungs, one stomach, one telephone system, each doing specific work. The general problems, therefore, appertaining to men, to materials, to machines or equipment and to methods or conditions, can be initially divided into four groups. All four groups, which more or less interweave, should come under one chief of staff. Under him should be various heads of staff. The subdivisions of the staff depend on the particular business, but a general scheme, modified to meet special conditions, would be that of the four groups mentioned.

AS TO MEN.

1. A head of staff to plan, direct and advise as to everything appertaining to the well-being of the employees. This is in itself a very extensive and important department of staff activity. Men should not be able to connect themselves with a company except after examination as to their moral, physical and professional fitness. Everybody knows that one quality of steel will cut four or five times faster than some other quality, and a modern tool is selected not because it has the shape of a drill but because it is of a composition that can be made into a good drill or into any other good tool. Men are still selected not on account of qualities that would make them good in any particular direction, but because at the moment they call themselves this or that. Having entered the service of a company with difficulty, it ought to be a catastrophe for a man to leave it, because, while with it, so much appertaining to his physical, financial and professional welfare was provided, so much he could not by any possibility provide for himself.

The line organization of a staff head in charge of welfare would extend down to where it was available with its advice and help to the humblest worker. There is no reason, for instance, why a watchman, whose business it is to look for bad conditions, should not combine the duties of a watchman with those of welfare work and advice. He would meet special cases that would otherwise escape observation and report, and carry them up to his staff superiors, but he would also have been instructed by his staff superiors and given standards by them as to all usual conditions, so

that he would have at his fingers' ends standards for the use of the workers, standards evolved by specialists of the highest rank.

AS TO EQUIPMENT.

2. A head of staff to plan, direct and advise as to everything appertaining to the adjustment of structures, machines, tools and other equipment to the work in hand. There is very little difference between good handling of equipment and good handling of men. The rules that apply to the one case will generally apply to the other. Much has been learned about the proper care of men from methods evolved for the care of equipment, and much has to be learned about the care of equipment from methods evolved for the guidance of men. It is not to be forgotten that in the human organism the whole is incapacitated by a seemingly slight injury to a single part. No man will work efficiently with a cinder in his eye, or a splinter under his nail. Neither will a plant work efficiently if little things go wrong. Single items of equipment are often of very great perfection, whether a Corliss engine or a twist drill, but from twist drill to general design and equipment of plant everything is usually wholly out of relation and balance. Recently, in consequence of staff organization, it was found necessary to relocate over three-quarters of all the machines in two large and fairly modern plants. Each machine had been doing good work by itself and no one looked further, but the moment its relation to other machines or to the progress of the work was investigated, the conditions at once appeared impossible and unbearable. It is expected that this relocation of machines, together with other staff reforms, will result in an increase of output of 40 per cent without additional men or equipment. The high officials of every railroad point out the glaring defects of early location or equipment—the fact, for instance, that out of 600 locomotives there were 550 different types, instead of 6. The earlier builders had no staff advice.

This staff line in charge of the use of equipment also extends down until it is within reach of the worker. An example will show both the nature and the effects of staff organization. A staff was organized on a transcontinental railroad to advise generally as to the care and operation of shop machinery and tools. The duties of the staff, which extended from the vice-president's office downwards, were:

a. To secure suitable machines and equipment;

b. To give them the best possible care; and

c. To give the workers advice and directions as to how to use the equipment most efficiently.

The expense of maintaining shop machinery and tools, on this railroad for the year 1903-4 was $487,171; the unit cost in relation to output was $10.31. On a competing and largely parallel railroad, working under similar conditions, the cost in the same year was $487,150, and the unit cost, $9.55. As a result of staff activity and control on the first road, by the year 1906-7 total costs had fallen to $315,844, and unit costs to $4.89, but on the other road, where line organization was not supplemented by staff organization, the total costs rose to $638,193, unit costs remaining virtually constant at $9.81. This saving in expenses of $322,000 was brought about by a staff costing less than $10,000 and the $10,000 is included in the $315,844.

One subdivision of this maintenance problem was the care of belting. This had cost (for maintenance and renewals) at one of the main shops about $12,000 a year, and it was so poorly installed and supervised that there was an average of twelve breakdowns every working day, each involving more or less disorganization of the plant in its parts or as a whole. With the authority of the vice-president and in conjunction with the general purchasing agent, the whole subject of belting was taken up. A few general rules were laid down:

a. That the quality of the belts should be the best obtainable;

b. That the installation and care of belting should be put under the care of one competent man; and

c. That he should so maintain belts as to prevent breakdowns. The worker in actual charge of belts, a promoted day laborer, was given standards, took his directions from a special staff foreman, only one of whose duties was knowledge as to belts. The foreman had received his knowledge and ideals from the general chief of staff, who had made belts a special study, and this general chief of staff was in the first place inspired and directed by a man who had made a nine-years' special study of belts and who was the greatest authority in the world on the subject. The belt foreman had as much of this knowledge at his call as he desired to absorb, but he in turn was in immediate contact with each individual belt, with the machine it was on and with the worker using the machine.

The chief of staff learned as much from the belt foreman as the belt foreman learned from the chief of staff. The cost of maintaining belts fell from $1000 a month to $300 a month, the number of breakdowns declined from twelve each working day to an average of two a day, not one of them serious, and even the few breakdowns were due almost wholly to defective installations, such as narow pulleys, which it was impossible to remedy without unjustifiable expense.

AS TO MATERIALS.

3. A head of staff as to materials, their purchase, custody, issue and handling. Subsidiary materials are only too often purchased on the basis of price per pound rather than on basis of cost per unit. This is inevitable, since no one is able to give the purchasing agent any standard as to cost per unit. After materials are purchased they are frequently given such poor custody that they deteriorate or disappear before being used. They are still more often issued for extravagant and wasteful use. The economical handling of materials is a special art. In a large steel plant, staff control of handling material reduced the cost of handling per ton from $0.072 to $0.033, and increased the number of tons handled per man per day from 16 to 57. Here again was the same kind of staff organization, calling down from the top all the most valuable knowledge in the world as to this one subject, working up from the bottom from actual daily contact with changing conditions.

AS TO METHODS AND CONDITIONS.

4. A staff head as to conditions and methods, including standards, records and accounting. It has been found practically impossible either to maintain standards or records unless they are tied into the accounting. This is because there are standards as to money entries and none as to times or performances. This does not imply that records or standards shall be an outgrowth of accounting. Either is quite as important as accounting, and if a choice had to be made between good accounting coupled with bad practice and good practice coupled with bad accounting, most practical men would choose good practice. It is because at the present time good accounting is unrelated to good practice that extensive accounting is viewed with such extreme disfavor by the practical man. Standards are wholly distinct from accounting,

records are wholly distinct from accounting, but all three gain greatly when tied in together. It is virtually impossible to maintain records unless there are standards of performance, but these can never be evolved from either records or accounting. The determination and establishment of standards is a peculiar art, yet one of fundamental importance, for, without a sea level from which to start there is no measuring of mountains or of absolute heights. Railroads and industrial plants have systems of accounting based on the same general plan, but their records are not similar, so that it is difficult, if not impossible, to compare performances on one railroad with those on another railroad. There are certain records at the top, there is occasionally a certain semblance of a record at the bottom, but between the bottom record, on which, after all, everything rests, and the top record which is supposed to reveal the condition of the company, everything is vague and disconnected. It is astonishing, almost pathetic, that presidents' reports and Wall Street publications solemnly print costs per locomotive mile or cost of fuel per 1000 ton miles when the initial records out of which the final reports are built up are wholly unreliable.

With a staff specialist on records, with record specialists under him reaching down into intimate, hourly and departmental touch with the worker, every gang boss, every worker could confide to him his desires and his needs. A good record may increase the output of a machinist quite as effectively as a good belt or tool, as good material, and when the worker needs help of this kind he should have it at hand. The writer knew a worker on time allowance for every job. The company was satisfied with 100 per cent efficiency, but this particular worker had set himself a standard of 120 per cent, his earnings depending on his monthly efficiency. To attain this he could not afford to lose track as to any single day; he had to know, in fact, how he stood as to every job during the day. He, therefore, needed a record of both his standard and actual time. An ambition of this kind is of extreme value to the company, not only because it decreases the cost and increases the output and reliability of the man, but because of its effect on all the other workers. This man made out his own records, on awkward and unsuitable blanks, and they were kept in such a way as not to fit in with or be of any value to the general scheme. Here was a case where the desire of the worker could well have been

assisted by the skill of the specialist, each learning much from the other and together evolving a form of record of universal, optional use. Had any question come up beyond the skill or the authority of the local record man, he could have taken it up with his superiors until it had met and been solved by the grade of talent required.

Standards of performance are not less of a general character than records. In railroad operation the only work which is accomplished in a definite predetermined time is the running of the passenger trains. The Pennsylvania Railroad, for instance, reports that it ran its 18-hour train from New York to Chicago 312 days out of 366 exactly on time, an arrival efficiency of 85.24 per cent. In April the Chicago train arrived in New York 28 days out of 30, or 93.33 per cent on time, being on one of the two days only 1 minute late. Probably this train runs with a time accuracy of 99.9 per cent, if one should add up all the standard time minutes in the year and divide by the actual time taken. Perhaps the Pennsylvania Railroad keeps similar efficiency check on other passenger trains, but how about all its other items of expense incurred for either material or time? Do they also show 99 per cent efficiency or would they show about 60 per cent efficiency? If standards were established, if records were kept, it would be possible soon to attain almost automatically the same high efficiency as is now shown in the 18-hour train. It has cost money, a great deal of money, to run the 18-hour train as efficiently as it runs. It would save money, a great deal of money, to run other operations on a 100 per cent schedule.

Both accounting and records are very greatly simplified when connected up with standards. When the housewife buys a pound of tea or of meat she hands over the money and she receives in return a definite and agreed-upon equivalent in weight. This is exactly what the railroad company or the manufacturing concern does not do when it pays for services. The company does not even know what it ought to receive as service in return for the money paid, and so it accepts, not what it ought to receive, but what the payee gives, generally much less than it is entitled to.

The result of perfected staff organization is that everything is well and quickly done when and where wanted, that all costs are predetermined, that the responsibility for any deviation is immediately located, that the heads of both line and staff can direct far

better than they are now able to, that costs of performance decrease, and that output from the same equipment and men increases. The staff is to the line what the good road is to the automobile. Without it neither speed nor smooth running nor economy is attainable.

IV. STANDARDS; THEIR RELATIONS TO ORGANIZATION AND TO RESULTS.

Preservation and perpetuation is one of Nature's most important laws; therefore, line organization which is self-perpetuating is essential, it being a detail whether the chief and officers of the line are individuals or commissions or a semi-staff. Line organization, from its nature, will always be mediocre and inefficient unless handled by an extraordinary genius like Napoleon. The mediocrity is not one of individuality but of organization. Promotion is not by merit, since this would destroy the essential feature of line (its property of self-perpetuation), but advancement is by seniority. The youngest member is as capable potentially as the highest, and whether he rises to supreme command in five years or in forty-five depends on opportunity. When he has reached the age of retirement he gives way to a junior as one day gives way to another. There was nothing worth preserving and the elimination of the temporary head produces a desirable wriggle of life all the way down the line.

Line organization needs few standards, usually crude and often fictitious. Seniority or precedence is one of its standards, and closely interwoven is the fundamental standard of immediate and unquestioning obedience almost as automatic as the obedience of sheep to the leader. This simplicity of standard eliminates mental, moral, and physical perplexity. A chief of line may have many personal standards. He may not permit men to be recruited for his guard unless seven feet tall, the idiosyncrasy of the first king of Prussia, or he may uniform them in tall beavers and scarlet coats, or he may dress them like cowboys and call them rough riders, or as in the German and French and Russian armies there may be most punctilious standards imposed as to dueling.

Line organization can be defined as a self-perpetuation of a good average with the one standard of obedience.

Because it is the exact opposite, staff is a strengthener to line. It is not self-perpetuating but distinctly selective. The youngest

captain in the German army assigned for staff duty, is perhaps the highest special authority on aeroplanes. Promotion is not upwards but outwards, just as the Wright brothers, who began by specializing on aeroplanes in their home field in Ohio, are now the recognized authorities in the United States, France, England, and Germany, in aeroplanes, but in nothing else.

Instead of there being one main standard, obedience, causing no perplexity—instead of subsidiary fanciful standards—there is an unlimited multiplication of scientific standards, higher than all personality; and the staff expert, instead of receiving all the law and gospel from his chief, receives general principles only, but himself furnishes his chief with personally perfected standards, which it is the duty of the chief to adjust and incorporate in the general plan.

A staff without general standards, a staff officer without special standards, either expressed or felt, is a misnomer.

The standards of the staff are not scientific abstractions, but are evolved for the use of the line, the sole justification of the standards being that they will make line work more efficient. Staff standards being for the benefit of the line and often intrusted to line officials, must be put in the form of permanent instructions so that all may understand what is being aimed at, and deviations by the line be marked and reprimanded.

During the Cuban campaign, in a road over which many hundred army wagons were to pass, there was a mud hole. The first transport wagon, obeying the command to proceed to destination, floundered into the hole, had to be unloaded, dragged out, and reloaded. The crew had neither authority, skill, nor equipment to mend roads, so they passed on. Also there were no written staff instructions as to what a line official should do when he found the road impassable, so the second wagon coming along a few hours later, plunged into the same hole and experienced the same delay and trouble. In turn each of the several hundred wagons repeated the same performance, and although this road was in constant use for several months no attempt was made to mend it. Had there been as much sense of staff as in ant-hill activities, the first wagon would not have passed on without bettering the conditions for those who follow, instead of leaving them worse; had there been even elementary staff, one wagon only would have gone into the hole, which would then as a matter of course have been eliminated.

Had there been perfected staff, even the first wagon would not have passed over the road until it had been put in condition.

A sign post definitely stating distance, character of road, steepness of grades, to next town, is not in any way an imposition on or impediment to the wayfarer, whether on foot or in automobile, but is a valuable help. The sign post is a staff, without authority, except as imposed on the line by a line officer, a staff without value except as to its own special and limited information.

Staff standards are infinite and ever-changing. The best practice of yesterday is the laughing stock of to-day. The work of the expert is never done. The aeroplane flight of 6 miles last year becomes 60 miles this month, 600 miles next year. The chief of staff, who is to inspire the search for higher standards, who is to handle them with common sense, must himself be governed by elemental natural truths, his standards, used as a test for all the others, and these highest standards are psychical and physiological rather than physical. The four psychological requisites for a chief of staff are: (a) Faith, in men, in equipment, in methods and in standards; (b) an enthusiasm that inspires and creates confidence; (c) ultimate highest ideals; (d) very great rapidity of action.

Faith in men, faith in equipment, faith in methods, faith in standards must be so great as to inspire a contagious enthusiasm not only in the junior staff members but also in all the members of the line from commander-in-chief down to private. No man is fit to be a member of a staff who does not delight in his work, who does not consider it quite the keystone of the arch, who does not bend it wholly to the interests of the line, so that the line will recognize that through staff presence and staff endeavor, line work is made safer, higher, more pleasurable and more profitable.

The chief of staff must believe that the great majority of employees, nine-tenths, at least, can be easily influenced to do what is right, and prefer to do what is right, and that if the right course is made easy, it will be automatically followed, just as most people naturally keep to the sidewalk, although there are no rules ordering them to do so. Policemen are armed with clubs not to intimidate the well-behaved many but to terrorize the exceptional few. After the first prejudice against any innovation is overcome, staff standards must continually appeal to those for whom they are set up.

The chief of staff must assume, until the contrary is proved,

that existing equipment and existing facilities utilized to fullest efficiency can meet most requirements, that it is better to improve than to substitute, that Goliath can be slain with a sling and that the western road to India can be discovered with a caravel.

No man is fit to be either chief of staff or staff junior who does not have and adhere to high ideal standards. This fidelity to abstract principles is necessarily foreign to the line. A type setter is a member of the line. He achieves, obediently following the manuscript; but the proof reader is a member of the staff and maintains standards. Between them, perfect work is turned out.

The chief of staff and all his juniors must be alive to the value of rapidity of action. Seconds, minutes, hours and days are to the staff what hours, days, months and years are to the line. Staff ideals of the value of rapidity are found in the instantaneous action of a boxer or fencer where delay of the hundreth part of a second to meet an expected condition may result in death; are found in the activities of the weather service which receives reports from territory 6,000,000 miles in extent, compiles and digests the information, and publishes to-morrow's weather before noon to-day, to all the world over land and sea; a delay of a few hours would make the whole work valueless. Staff ideals of speed reacting on all the line are found in the work of a daily paper which collects the news of the whole world until the night is half gone, goes to press at two in the morning, and reaches distant customers at 6 a. m.

A proposition was made to the line officers of a large corporation to reduce expenses $2,000,000 per annum. Whatever the time required to accomplish this, every day's delay caused an irretrievable loss of $6666; yet details that ought to have been decided in 8 minutes were allowed to wait for 8 months. Line traditions vitiated staff ideals and as the line lasts forever it is not imbued with speed ideals. It was quite in accordance with line tradition that the wars between France and England lasted 100 years, that the religious wars in Germany lasted 30 years, that the wars of Frederick the Great lasted 7 years, that the French European wars lasted 26 years, that the war of the American Revolution lasted 7 years, the wars of the Rebellion 4 years—but that the staff-prepared war of von Moltke's Prussian army against twice as strong a territorial and numerical coalition lasted 2 weeks, and von Moltke's staff-prepared war of Germany against France cap-

tured the French emperor and the French armies and ended the French empire in 7 weeks after outbreak.

In line, there is very little planning but a great deal of organization; in staff, it is all planning and very little organization.

Owing to absence of staff as part of their own organization, lines, all over the world, have been forced to depend on outside staffs, whose inspiration was generally tinged with pecuniary self-interest, so that the great shops and railroads and other industrial concerns have been as to men, machines, materials, and methods over-supplied and over-equipped, as when a $100,000 saw mill is erected to handle a $50,000 lumber tract. Many hundred million dollars have been spent in the last decade on fanciful betterments, when greater returns could have been obtained by standardizing what was.

In marked contrast to the lavish expenditure for inadequate returns from improvements in industrial and transportation concerns is the small expenditure and enormous return brought about in agriculture. The present depression in the great industrial division of American activity and the almost giddy prosperity of the agricultural division at once illustrate the fundamental difference in results and in methods obtained from line and staff activities respectively. The farmer is not lazy, he is not troubled by union limitations, and he has the enormous spur of direct and personal increase of reward for increased or more intelligent effort; he has moreover been at his business from birth; but the average result in crops is only about 30 per cent of what it ought to be.

There is no reason for assuming that industrial activities, entrusted to men whose interest goes no further than their daily wage, who were not born to the business, will average any higher in efficiency than the farming class, and in fact there is just as much difference between the average crop and the expert's crop as there is between the average output of a man and machine and the expert's output from the same man and machine. Two different influences are revolutionizing agriculture—the isolated special genius, and the staff adviser. The industrial field has had the isolated special genius but as yet very little staff assistance.

Because these essays on efficiency are applicable particularly to shops and railroads it is better to use illustrations from agriculture, since it is much easier to see the mote in the brother's eye than the beam in our own. Therefore the yield of potatoes will be used in

illustration. What is the limit of yield of potatoes from an acre of ground in the United States? The average yield per acre over a series of years is 96 bushels. Shall we therefore set 100 bushels as standard 100 per cent efficiency?

The lowest average in 1907, 65 bushels, occurred in the great agricultural State of Kansas; the highest average was in the desert State of Wyoming, 200 bushels to the acre. The highest average in Wyoming is due to one man, who issued a challenge of $1000 open to all the potato growers of Colorado, that he would raise on his Wyoming farm more potatoes per acre than any one could raise in Colorado, provided further that if he won the contest yet failed to raise 1000 bushels per acre, he would forfeit the whole of the stakes, $2000, to charity.

It is psychology, not soil or climate, that enables a man to raise five times as many potatoes per acre as the average of his own State, ten times as many per acre as the average of the United States, thirteen times as many as the average in the better soil and climate of Kansas. An easily attainable standard of potato raising is therefore not 100 bushels but 500 bushels which can be called 100 per cent efficiency.

On this basis the average of the United States is 19 per cent, the average of Kansas 12 per cent, the production of the Wyoming champion 200 per cent efficiency. If the United States attained as to potato raising an average efficiency of 50 per cent, the increased value of the crop in one year would be sufficient to pay for the Panama Canal; or, the acreage and labor devoted to potatoes could be reduced to 40 per cent of what it now is, and still yield as many potatoes.

Undoubtedly the potato champion, in a more favorable climate, where, with irrigation, three crops are possible, as in the Yaqui Valley in Mexico, would raise 3000 bushels per year per acre. They would cost him more per acre but less per bushel than any other potatoes in the world.

Individuals of this kind have inspired the Agricultural Department at Washington, working in conjunction with State Agricultural staffs, to standardize conditions for all staple agricultural products.

It has recently been asserted that with selected seed a standard attainable yield of wheat is 50 bushels per acre per year. The actual yield is 14 bushels; the total 650,000,000, when it ought to

be 2,500,000,000 bushels—yet there are charity bread lines in New York.

With a standard of 50 bushels per acre the efficiency average of the United States is only 28 per cent, the money loss at constant price over $1,000,000,000 per year.

The staff experts of the Agricultural Department have enabled Texas cotton growers to raise one bale per acre. Selected seed, suitable fertilizer, systematic cultivation is all that is required. The acreage of cotton is 32,000,000, the production only 12,000,000 bales; the efficiency is 37.5 per cent and the annual loss due to inefficiency about $1,000,000,000.

Italian bees in California raise twice as much honey as they do in Italy. The Californian bees do not work as hard, they live longer because most of the disagreeable work is eliminated. The staff experts advising the bees are men who standardize conditions both simply and effectively. The bees make honey instead of wasting time on hives, on foundations, on comb, and on long journeys to semi-barren flower fields.

The potato expert increased the efficiency of his fields to ten times the average; the owner of Alaskan seed wheat increased his yield to fourteen times the average; the corn and cotton staff experts have through their advice enabled whole counties of farmers to double the average yield of corn and cotton; the making of better conditions has increased the average yield of honey 100 per cent.

If we could put ourselves in touch with the feelings of plants we should probably find that there was much more enjoyment to potatoes in growing 1000 bushels to the acre than in growing 67 to the acre. Intensity of production does not mean physical exhaustion, but favorable conditions. Similarly, intensity of human production does not legitimately mean, and ought never to mean, the physical exhaustion of an over-worked victim, but should be due to the joyous stimulus of perfectly standardized conditions.

Examples from agriculture have been selected because far more has been done to establish standards of attainable production in agriculture than in factories, shops, and mechanical trades. The plant also will always do the best that circumstances permit and the circumstances are largely controllable. A man will rarely do his best even if circumstances are favorable; but as an offset it is more easy to control factory, transportation, shop and handwork

conditions than to control seasons, climates, diseases, and insect pests. On the whole, the efficiencies of industrial organizations are no higher than those of farming activities, and as staff standards indicate possible increases of 200 per cent in agricultural yields, so staff standards and staff assistance will bring about 200 per cent increased efficiency in materials and services in industrial organizations, including railroads. Tests show that this can be done.

The standardizing of belt practice by staff study has increased the average life of belting more than six-fold, has reduced belt failures to one-sixth of what they were, has decreased annual cost to less than one-seventh.

The discovery and perfection of high-speed steels did not originate in any shop but was exclusively developed by men whose ideals and practices were those of the staff, and high-speed steel accomplishes four or five times as much as the old carbon steels.

Staff selected and designed abrasive wheels cut four times as fast as the old grindstones and every grade needed can be made to order, standardized for each different kind of work; files that are standardized as to quality last five times as long and cut much faster than the usual good commercial files.

Wherever the staff expert turns, he finds that standard time and cost for some units of work can be reduced to one-half, for other units to one-quarter, occasionally to one-tenth, the average time for the unstandardized work.

Railroad practice has many standards, chiefly those of specification, construction, and times for passenger trains. No railroad has ever determined any cost standards either for maintenance or operation of equipment, maintenance of way, or consumption of fuel; yet there is no railroad in the country on which each one of these cost standards could not be determined in a very short time and with very close accuracy, at a cost equal to the saving effected in a single month.

When each unit of locomotive repair is standardized, the sum of the units shows a cost between $0.03 and $0.06 a mile for maintenance. The actual average costs on the railroads are between $0.06 and $0.12, therefore twice what they ought to be. The standardized cost of maintaining freight cars is as low as $30 per annum. Actual average costs run from $45 on some roads to over $100 on others. Standards of maintenance of way vary, but in-

numerable assays of actual work show a maintenance-of-way labor efficiency of scarcely more than 30 per cent.

Staff determinations with a dynamo car showed that 1,000,000 B. t. u. in the coal were amply sufficient to furnish power to move a 1000-ton train one mile. The actual coal charged to locomotives always contained more than twice as many, often three times as many, B. t. u.

The average mileage of the locomotives of the United States is close to 30,000 per year, about 82 miles per day. Average mileage of a freight car is about 25 miles per day. Staff standardization in locomotive repairs not only decreases the cost to one-half as much per mile, but also increases the mileage at least 33 per cent.

Locomotive repairs cost twice what they should, not because men in charge are not of the highest ability and experience, but because these men are so hampered by line organization that it is almost impossible for them to evolve standards or to maintain standards when evolved. Standards are always of the microscope, of the assayer's balance, of infinite patience applied to the smallest of details. It is not important that absolute zero is at — 273 degrees and that the highest temperature in the sun is 10,000 degrees, but it is important that human life is snuffed out if the temperature of the body rises 5 degrees centigrade.

It is not important that space is so vast that it takes hundreds of light years for the light of distant stars to reach us, wireless telegraphy on a stupendous scale, but it is important that the yellow fever bacillus may lurk in the saliva of a mosquito, so small that the microscope has scarcely yet discovered it.

It is not important that pressure varies from nothing in vacuo to so much at the deepest spots in the sea, that an air bubble taken down there becomes heavier than water and cannot rise to the surface, to so much at the earth's center, even if there were free opening to the surface, that the air would be heavier than gold, harder than titanium, so that a needle could not be driven into it, yet if in it, would slowly move surfacewards until specific gravity of air and needle were the same. These facts, interesting though they are, do not concern us as much as the fact that men cannot work on high mountains without danger nor in caissons without risk of the "bends," and that half the power put into air compression is lost in pipe leaks.

The staff chief and his assistants in search of standards, are not

using bolometers to measure the ten-thousandth part of a degree, nor the spectroscope to measure the speed of advance or recession of the fixed stars, nor ruling diffraction gratings 900,000 lines to an inch, nor are they interested in either the North Pole or in the transit of Venus; but they are searching for common, every-day, practical and attainable standards of which astounding few have been determined.

Time is infinite, but that does not concern us so much as that five minutes of suspension of breathing or heart beating carries us over the boundary that separates life from death.

Congress has determined that a dollar (not now coined) shall consist of 25.8 grains of gold nine-tenths fine, but it may be a shock to learn that Congress has never determined the grain or any other standard of weight or of length or of time. The United States Treasury Department has adopted a gallon and a bushel, but neither is in accordance with the legal standards of Great Britain. They not only differ from the present standards of Great Britain, being respectively 17 per cent and 3 per cent smaller, but they also always differed from the discarded English standards from which they were derived.

On April 15, 1903, the Superintendent of Weights and Measures, not Congress, directed that the international metre and kilogramme should be in the future regarded as fundamental for metric and customary weights and measures. Congress, which has failed to legalize standards either of weight or of length or of capacity, has however standardized the spelling of Porto Rico and the motto "In God We Trust" on the dollar, and it is safe to say that Congress has concerned itself more with this motto than with the fact that all the thousands of millions of dollars of railroad and industrial shares sank in October, 1907, 33 per cent in value in a few weeks, and that the earning power of hundreds of thousands of men, eager to work, fell from an average of $2.00 per day to nothing.

In Germany in the polytechnic schools as late as 1875 and perhaps now, mediæval standards of proper procedure in all matters appertaining to students' duels were more definite, punctilious, important than surprisingly lacking modern standards of scientific accuracy.

These examples of American legislative and German scholastic insistence on the puerile and neglect of the all-important almost

give the dignity of natural law to the statement that in standards insistence and excitement are in inverse proportion to practical every-day importance, and with such high examples as Congress and German universities it is not surprising that in the line organization of American industrial enterprises there is more sensitiveness about prerogative than in Congress itself, more alertness to take offence at the unimportant than in the German student.

The difficulties blocking the path of the radical improvement that would immediately result from supplementing the line with staff and standards, are the sensitiveness and apprehension of the line that, in some way it cannot explain, staff activity and application of standards will reflect on line ability, as if in the round-the-world automobile race, the benefits of good roads from Berlin to Paris and the speed made over the good roads, reflected on the capacity of the automobile drivers, who made slow yet astonishing progress through Siberia.

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THE AZIMUTH DIAGRAM, AND ITS AVAILABILITY FOR THE SOLUTION OF VARIOUS PROBLEMS IN NAVIGATION.

By LIEUT.-COMMANDER G. W. LOGAN, U. S. Navy.

As a result of inquiry of many navigating officers as to the method employed by them for solving the azimuth problem, it has been noted that comparatively few take advantage of the graphic method. A surprisingly large number are not aware that practicable azimuth diagrams are a part of the chart equipment of every naval vessel, while many that do know of the existence of the diagrams have not given them sufficient test to realize their advantages.

Several such diagrams are to be found in every chart outfit (in Portfolio I), and while it is not the purpose to discuss here their relative merits or detailed construction, the writer is able to speak particularly of Captain Weir's Azimuth Diagram, which he has used exclusively for many years and can commend for its facility and accuracy. This can be depended upon to give a solution of the time azimuth within one-quarter of one degree, and the result can be arrived at not only in far less time than with the azimuth tables but also with less chance of error, since the graphic method avoids the cumbersome arithmetical process required for interpolation of each of the three given quantities when the tables are used. It will be found especially easy to calculate a series of azimuths taken in the same declination and latitude with only slight intervals of time between, as when swinging ship—it being possible to work out a whole round of observations in a very short time.

One or two suggestions in connection with the use of the azimuth diagram may be offered. The sheet should be mounted like a piece of drawing paper (stretched and pasted) upon a draw-

ing board; it should then be covered with a coat of clear shellac, which makes it to some extent moisture-proof and enables it to be kept clean without difficulty. The points involved in any particular problem should be marked by pins stuck in vertically; if pencil marks are used for the purpose their number soon become confusing, or else the attempt to remove them by erasing defaces the diagram. Moreover, by bringing the parallel ruler into contact with the pins a quicker and more satisfactory result is obtained than by centering the edge of the ruler over pencil dots with the eye. Until some practice has been had with the diagram, it is advised that beginners supplement the results obtained from the diagram by checks obtained by some more familiar method—the tables or computation; like everything else of its kind, it is easy to put north where south should be or to fall into some similar error, unless perfect familiarity with its working has been acquired.

In connection with the azimuth problem, and especially in view of the ease of its solution by graphic methods, it is proposed to point out how practically every problem in nautical astronomy may be solved by the azimuth diagram (within the limits of accuracy of that diagram) by a mere re-naming of the parts involved. The possibility of finding the great circle course by azimuth methods has long been familiar; and a recent article by Lieutenant-Commander Rust in the NAVAL INSTITUTE PROCEEDINGS has shown how the azimuth problem is related to that of star identification. But the analogies can be extended to include every problem whose solution involves the relation between two sides and two angles of the astronomical triangle.[1]

In explaining these solutions, the following abbreviations will be employed:

h = altitude;
L = latitude;
d = declination;
t = hour angle;
Z = azimuth;
M = angle at body in astronomical triangle (position angle).

C = course,
$Dist$ = distance,
Dlo = diff. longitude,
L' = lat. departure,
L'' = lat. destination.

} great circle.

[1] This excludes the time sight and altitude azimuth. An altitude azimuth diagram will, however, be found in the naval chart outfit, which is available for the graphic solution of the two problems mentioned as exceptions.

When these letters are employed to denote a term of the *actual* problem under consideration the fact will be denoted by the addition of the subscript letter A; when denoting an equivalent term *on the diagram* which is employed for purposes of the solution, the subscript letter D will be added.

GREAT CIRCLE COURSE AND DISTANCE.

In this problem we have given L', L'', and Dlo, to find C and $Dist$. In Fig. 1 is represented the triangle involved in the solu-

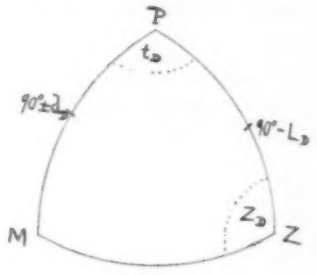

FIG. 1.

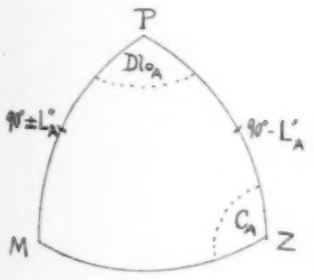

FIG. 2.

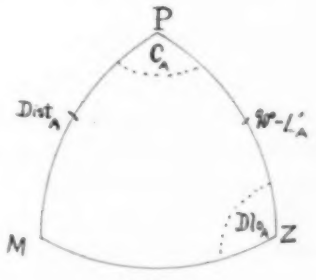

FIG. 3.

tion of the time azimuth, and therefore the one whose terms correspond in title with those of the azimuth diagram. In Fig. 2, we have the triangle of the great circle problem for finding the course, from which it appears that like parts are involved to those of the time azimuth; it is therefore evident that with a proper substitution of terms the solution will be identical. Similarly, in Fig. 3 we have the related parts for finding the great circle distance. Hence, to solve this problem by the azimuth diagram:

First, let $L'_A = L_D$;
$L''_A = d_D$;
$Dlo_A = t_D$;
then, $C_A = Z_D$.

Next, let $L'_A = L_D$;
$Dlo_A = Z_D$;
$C_A = t_D$;
then, $Dist_A = 90° \pm d_D$.

It will of course be apparent that while the diagram is prepared with a special view to finding the azimuth from latitude, declination, and hour angle, it is equally available, by an obvious modification of the instructions, for finding any one of the four quantities named when the other three are given; for example, with latitude, azimuth, and hour angle given, declination is readily found as required in the second step. It will also be evident that if L''_A is of opposite name to L'_A, d_D must be taken as of opposite name to L_D; and similarly if in the second step the solution gives d_D of opposite name to L_D, $Dist_A = 90° + d_D$, while if of the same name $Dist_A = 90° - d_D$.

Example: Given two places, one in Lat. 40° N., Long. 70° W., the other in Lat. 30° S., Long. 10° W., find the initial course and the distance by great circle.

$L'_A = L_D = 40°$ N.; $L'_A = L_D = 40°$ N.;
$L''_A = d_D = 30°$ S.; $Dlo_A = Z_D = 60°$ (from N.);
$Dlo_A = t_D = 60°\ (4^h 00^m)$. $C_A = t_D = 131°\ 15'\ (8^h 45^m)$.
Hence, $C_A = Z_D =$ N. 131° 15′ E. Hence, $Dist_A = 90° \pm d_D$
$90° - 0°\ 45$ N.
$= 89°\ 15' = 5355$ mi.

The solution giving d_D of the same name as L_D, the polar distance, which corresponds with $Dist_A$ is less than 90°. This same problem is solved by computation in the revised Bowditch (p. 58), and the course found to be N. 131° 24′ E., and distance 5364 miles.

It is evident that by successively assuming various values of Dlo_A (Fig. 2) and with Dlo_A, L'_A, and C_A as known terms, a series of corresponding values of L''_A could be found; or else by successive assumptions of L''_A the corresponding values of Dlo_A could be determined; thus the whole great circle track may be plotted on a Mercator chart.

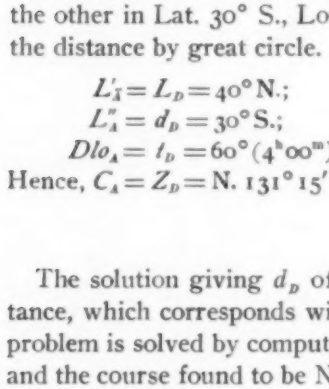

FIG. 4.

STAR IDENTIFICATION.

In this problem, the given terms are L, Z, and h, and it is required to find t and d. The method of determination of the hour angle is illustrated in Fig. 4, and the analogy of this to the time azimuth problem will be apparent from comparison with Fig. 1. In the second

step, the determination of the declination, the terms are identical with those of Fig. 1.

First, let $L_A = L_D$;	Next, let $t_A = t_D$;
$h_A = d_D$;	$L_A = L_D$;
$Z_A = t_D$;	$Z_A = Z_D$;
then, $t_A = Z_D$.	then, $d_A = d_D$.

In the first step, except in the unusual case of the zenith distance being greater than 90°, d_D should be assumed as of the same name as L_D. In this problem, as elsewhere in solutions by the azimuth diagram, confusion will be avoided by invariably reckoning the azimuth *from the elevated pole* eastward or westward through 180°.

Example: In Lat. 5° N., observed a star at altitude of 38° bearing N. 107° E. (true). Required its hour angle and declination for purpose of identifying the body.

$L_A = L_D = 5°$ N.;	$t_A = t_D = 50° (3^h 20^m)$;
$h_A = d_D = 38° (N.)$;	$L_A = L_D = 5°$ N.;
$Z_A = t_D = 107° (7^h 08^m)$.	$Z_A = Z_D = 107°$.
Hence, $t_A = Z_D = 50°$.	Hence, $d_A = d_D = 10°\ 15'$ S.

These results will be found to accord with those obtained by an independent method in the revised Bowditch (p. 127).

TO FIND AZIMUTH AND ALTITUDE.

In this problem we have given t, d, and L, to find Z and h. It is of value for giving an approximate solution of the problem presented by the Marcq St. Hilaire method; and while the result in altitude is not sufficiently exact for navigation purposes it may serve as a check upon the accuracy of a solution by computation. It may also be of value in giving the position in which to look for a body of which an observation is to be taken; thus, by setting the sextant at proper altitude and looking at the horizon on the proper bearing the body may be picked up with the telescope before being seen by the naked eye and the observation taken with a brighter horizon.

The first step in this problem is identical with the solution illustrated in Fig. 1; for the second step, the conditions accord with those of Fig. 4.

First, let $t_A = t_D$;	Next, let $Z_A = t_D$;
$L_A = L_D$;	$L_A = L_D$;
$d_A = d_D$;	$t_A = Z_D$;
then, $Z_A = Z_D$.	then, $h_A = d_D$.

Example: In Lat. 37° 18′ N., Dec. 22° 49′ N., the hour angle being $4^h\,03^m\,36^s$. Required the azimuth and altitude.

$t_A = t_D = 4^h\,03^m\,36^s$; $Z_A = t_D = 87°.4\,(5^h\,50^m)$;
$L_A = L_D = 37°.3$ N.; $L_A = L_D = 37°.3$ N.;
$d_A = d_D = 22°\ 8$ N. $t_A = Z_D = 60°.9\,(4^h\,03^m\,36^s)$.
Hence, $Z_A = Z_D = 87°.4$. Hence, $h_A = d_D = 36°.4$.

By computation, it will be found that the exact altitude is 36° 16′.

TO FIND LATITUDE BY ALTITUDE OFF MERIDIAN.

In this case, the given quantities are t, d, and h, to find L. This problem, familiarly known as the $\phi'\phi''$ method, may be approximately solved by the graphic process to serve as a check upon a computed result. It is, however, given here more for the purpose of completing this series of solutions than because of its practical value; and it may be remarked that when, as frequently occurs, the value of h_A $(= d_D)$ exceeds 60°, a limitation is placed upon the availability of the diagram.

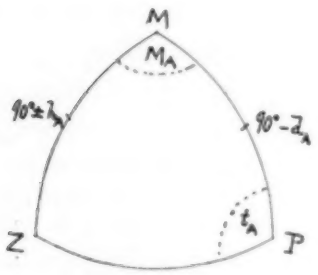

FIG. 5.

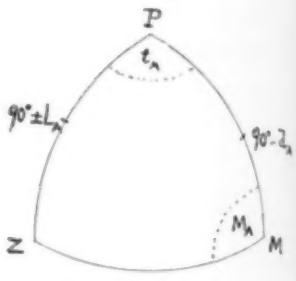

FIG. 6.

Comparing Figs. 5 and 6 with Fig. 1:

First, let $h_A = d_D$; Next, let $t_A = t_D$;
$d_A = L_D$; $M_A = Z_D$;
$t_A = Z_D$; $d_A = L_D$;
then, $M_A = t_D$. then, $L_A = d_D$.

Two solutions will be given, corresponding respectively to upper and lower transit, between which it will be easy to distinguish. The pole to be taken as the elevated pole for measurement of Z_D must be that of the same name as the declination, since d_A is taken to correspond with L_D; and since the actual zenith distance becomes the polar distance of the diagram (Fig. 5), d_D $(= h_A)$

should, except in the unusual case of a negative altitude, be given the same name as L_D $(= d_A)$.

Example: The corrected altitude of Sirius (declination 16° 34′ 40″ S.), was found to be 40° 44′, and its hour angle $0^h\ 40^m$. Required the latitude.

$h_A = d_D = 40°.7$ (S.); $t_A = t_D = 0^h 40^m$;
$d_A = L_D = 16°.6$ S. $M_A = Z_D = 168° 30'$ (from S.);
$t_A = Z_D = 10°$ (from S.). $d_A = L_D = 16°.6$ S.
Hence, $M_A = t_D = 168° 30' (11^h 14^m)$. $L_A = d_D = 31°.9$ N.

The computed value in this case is 31° 45′ N.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE LUNAR OBSERVATION WITHOUT DISTANCE TABLES.

By H. B. GOODWIN.

The navigator of to-day, who requires some independent check at sea upon the behavior of his chronometers finds himself in some countries confronted by a new problem. It has long been recognized that the only practicable method of obtaining such a check is derived from the observation of a lunar distance, and tables of such distances, calculated for three-hour intervals, have for many years been included in almost every nautical ephemeris. Owing, however, to the perfection arrived at in the construction of chronometers, to the general shortening of voyages due to the very general substitution of steam power for sail, and other causes, the tables in question have fallen into comparative disuse, and a few years since the French "Bureau des Longitudes" determined to suppress them. Accordingly, in the "*Connaissance des Temps*" for the year 1905, the tables of distances, which had retained their place in the French official ephemeris for a period of 131 years, were for the first time omitted.

The British Admiralty was not slow to follow the example thus set upon the other side of the Channel, and in the Nautical Almanac for 1907 the distances found no place. The American "Ephemeris and Nautical Almanac," it is true, supplies tables with the same liberality as of old, but having regard to the important step taken by two of the leading maritime countries, and to the possibility that the new departure taken may be more generally adopted later it becomes a matter of interest to see how, without the aid of special tables, Greenwich mean time may be deduced from an observed lunar distance with as little additional labor as possible.

The data given in the Nautical Almanac, wherein the values

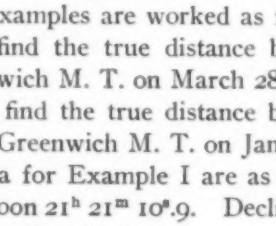
of moon's right ascension and declination are tabulated for each exact hour of Greenwich M. T. supply ample means of calculating for ourselves the distances formerly taken at sight from the tables, and in the "Explanation" given at the end of the 1908 British Almanac specimen examples are worked as follows:

Example I. To find the true distance between the sun and moon at noon Greenwich M. T. on March 28, 1908.

Example II. To find the true distance between Regulus and the moon at 4 p. m. Greenwich M. T. on January 17, 1908.

The necessary data for Example I are as follows: R. A. sun $0^h\ 27^m\ 12^s.9$, R. A. moon $21^h\ 21^m\ 10^s.9$. Declination sun $2°\ 56'\ 31''$ N., declination moon $18°\ 39'\ 30''$ S.

From these data any one at all versed in nautical calculations will have no difficulty in obtaining the required result.



Thus in the triangle *PMS*, if *S* and *M* are the positions of sun and moon respectively we shall have *PS* the polar distance of sun $= 87°\ 3'\ 29''$, and *PM* the polar distance of moon $= 108°\ 39'\ 30''$, the included angle furnished by the difference of right ascensions being $3^h\ 6^m\ 2^s$.

With two sides, and the angle included between them therefore we can find the third side *MS* by the ordinary trigonometrical process, the value in this case being $50°\ 35'\ 42''$. The operation being repeated with the values of right ascension and declination for 3^h Greenwich M. T., we shall have the means of dealing with any observation taken between Greenwich noon and 3^h p. m. on the day in question.

Although simple enough in principle this method is open to objection on account of its length. To be of any practical use

the calculations must be made with considerable nicety to the nearest second, and the process of proportioning for seconds is very tedious, so that the solution of the two triangles adds very greatly to the labor formerly involved. Moreover, unless we are willing to omit the "Correction for Second Differences," which may easily amount to several seconds of time, even two solutions would not be sufficient, but an additional one would be required, with a corresponding increase of the toil of computation.

An alternative method suggests itself, which would be very generally available for star distances, and which would involve one solution only of a spherical triangle instead of two, or in place of three, if the "Correction for Second Differences" is to be taken into account.

The method proposed is as follows: In the diagram given above let S and M represent the places of star and moon respectively, the distance SM having been cleared of the effects of parallax and refraction. The three sides PS, PM, MS, that is, the two polar distances and the true distance being known, we may calculate the value of the angle SPM, which represents the difference of right ascension between the bodies. Now the value of the star's right ascension being also known with great accuracy we have only to add or subtract the difference of right ascension determined as above, and we have the exact value of the moon's right ascension at the instant of observation. From the value of the right ascension so obtained we deduce by proportion the corresponding Greenwich M. T. by means of the "rate of change" per minute given in the Nautical Almanac.

With reference to the applicability of the method it should be observed that one of the data made use of is the declination of the moon. To obtain an accurate value of this we must know the Greenwich M. T. But in the first instance the Greenwich M. T. is only known approximately, and it is important therefore that the observation should be taken under such conditions that a small error in the declination will have no material effect upon the value of the angle deduced from it.

Now if there is a small inaccuracy (dp) in the value of the declination employed, the resulting error in the angle MPS is given approximately by the expression

$$\cot PMS \,.\, \sec d \,.\, dp,$$

d being the declination of the moon.

From this expression it follows that the angle *PMS* should be as nearly 90° as possible, and when it is exactly a right angle the error vanishes altogether. Between 80° and 100° the error will always be less than one-fifth of the error in declination, and these limits, viz. 80° and 100°, may therefore be adopted approximately for the value of the angle *PMS*.

To find an approximate value for this angle *PMS* we may employ the azimuth tables in the following manner: Take out the moon's R. A., and by comparison with R. A. star find an approximate value for the angle *MPS*.

With declination of moon as latitude, declination of star as declination, and *MPS* as hour angle, take out the azimuth from the tables. This will represent the value of *PMS*.

The full process will then be as follows:

By means of the azimuth tables find a star or planet suitable for observation, that is, having the angle *PMS* not much less than 80° or greater than 100°.

Take out R. A. and declination of selected star, and declination of moon.

With the three sides, viz., the two polar distances and cleared lunar distance, calculate the angle *MPS*, which is the difference of right ascension between the bodies.

Apply this difference to R. A. star, and thence obtain R. A. moon.

By means of the tabulated value of moon's R. A. and "rate of change" per minute find the corresponding Greenwich M. T.

For an illustration of the method we may turn to the case selected as a specimen example in the "Explanation" to the British Nautical Almanac for 1908, involving the moon and Regulus. This is stated as follows:

To find the true distance between Regulus and the moon at 4^h p. m. Greenwich M. T. on January 17, 1908.

From ephemeris we have R. A. star $10^h\ 3^m$, R. A. moon $7^h\ 11^m$ approximately, so that the angle $MPS = 2^h\ 52^m$. Declination star 12° 25′ N., declination moon 22° 38′ N.

From the azimuth table for latitude 23° (moon's approximate declination), declination 12° of same name, and hour angle $2^h\ 52^m$, we have azimuth 97° 32′ or 7° 32′ more than a right angle. The angle *PMS* has therefore a suitable value. In the Nautical Almanac the distance required for 4^h p. m. is worked out by

trigonometry and found to be 42° 6′ 32″. We may therefore utilize this result, and frame an example which will illustrate the working of the proposed method.

Let us suppose that about 5^h 10^m p. m. on January 17 the cleared distance was 41° 32′. Required the Greenwich M. T.

This will be first calculated by the Nautical Almanac process, and secondly by way of the moon's right ascension, and the results can then be compared.

In the almanac the R. A. and declination are taken out for Greenwich M. T. 4^h p. m., and also those for the star. Two sides and the included angle being thus obtained in the triangle *MPS* the third side is calculated and found to be 42° 6′ 32″, which is therefore the true distance at 4^h p. m. The calculation has then to be repeated for a second epoch. If the ordinary tables of proportional logarithms, adapted for three-hour intervals, are to be employed, this must be three hours later, viz., at 7^h p. m.[1]

The value which results from this calculation is

40° 37′ 48″,

which is the true distance at 7^h p. m.

The process is then completed as follows:

Distance at 4^h p. m.	42°	6′	32″		Distance at 4^h	42°	6′	32″
" observed	41	32	0		" 7^h	40	37	48
Difference		34′	32″		Difference	1°	28′	44″

Proportional logarithm	0°	34′	32″	.71703
" "	1	28	44	.30718
Difference				.40985
Angle *MPS*				1^h 10^m 3^s
				4
Greenwich M. T.				5^h 10^m 3^s

The distances which are still recorded in the American Ephemeris and Nautical Almanac enable us to check this result.

[1] If the "Correction for Second Differences" is to be taken into account, it would be necessary to make a third calculation, for 10^h p. m., which would be found to give 39° 9′ 9″. Thus between 4^h and 7^h distance decreases 1° 28′ 42″, and between 7^h and 10^h, 1° 28′ 41″, so that the difference is so small that it may be neglected.

From the ephemeris we have

Distance at 3^h	Distance at 6^h
$42^\circ\ 36'\ 8''$	$41^\circ\ 7'\ 23''$

and it is required to find the G. M. T. for distance $41^\circ\ 32'$.

Distance at 3^h	42°	$36'$	$8''$
" observed	41	32	0
Difference	1°	$4'$	$8''$

	PL	4482
(From ephemeris)	"	3071
Difference		1411
G. M. T.		$5^h\ 10^m\ 4^s$

which agrees within one second with the result already obtained.

Dispensing with distance tables, by the proposed method the working would be as follows:

G. D.	Star's R. A.	Star's Dec.	Moon's Dec.
$5^h\ 10^m$	$10^h\ 3^m\ 28^s.6$	$12^\circ\ 24'\ 59''$ N.	$22^\circ\ 36'\ 57''$ N.
			10 —
			$22^\circ\ 36'\ 47''$ N.

	NPD	77	35	1
Cleared distance		41	32	

NPD 67 23 13

$77^\circ\ 35'\ 1''$	L cosec	.010279
67 23 13	"	.034741
$10^\circ\ 11'\ 48''$		
41 32 0		
$31^\circ\ 20'\ 12''$	$\frac{1}{2}\ L$ haversine	4.431477
51 43 48	"	4.639738
	L haversine	9.116235

Angle MPS = Diff. R. A.	2^h	49^m	$32^s.5$
R. A. star	10	3	28.6
(Difference) R. A. moon	7^h	13^m	$56^s.1$

From the ephemeris we have moon's right ascension at 5^h G. M. T. $7^h\ 13^m\ 34^s.6$, and difference for one minute $2^s.143$.

Hence, if x represents the time in minutes past five o'clock corresponding to the value of moon's right ascension $7^h\ 13^m\ 56^s.1$, we have

$$x \text{ (in minutes)} = \frac{7^h\ 13^m\ 56^s.1 - 7^h\ 13^m\ 34^s.6}{2.143} = \left(\frac{21.5}{2.143}\right)^m = 10^m.033.$$

Thus the Greenwich M. T. is $5^h + 10^m.033$ or $5^h\ 10^m\ 2^s$, which agrees within 2^s with the result obtained from the distance tables of the American Ephemeris.[2]

Proceeding thus it will be seen that as compared with the method proposed in the British Nautical Almanac we save one solution of a spherical triangle, and that no "Correction for Second Differences" has to be taken into account. The process is in fact about as much more lengthy than that in which tabulated distances are employed as it is shorter than the method recommended in the British Almanac for the lunar of the future.

Besides the error in moon's polar distance, which arises from the uncertainty as to the exact Greenwich date, another source of inaccuracy ought not to be left out of account, viz., the error arising from the necessary lack of precision in the sextant measurement of the distance.

If $d\theta$ represents this error, the corresponding error in the angle MPS, and consequently in the value of the moon's right ascension, is approximately

$$\text{cosec } PMS \text{ sec } d\ (d\theta)$$

where d is the declination of the moon.

It follows from this expression that the error in the angle MPS can never be less than the inaccuracy in the observation, but so long as the angle at M does not differ much from a right angle it need not be much greater. If 80° is taken as a limiting value for the angle PMS an error in the observation might be increased by about one-seventh of itself in the resulting angle at P, but this could only occur when the moon's declination is near its maximum value of about 28°, a value which is rarely attained.

With regard to the applicability of this right ascension method it will generally happen that one or more bright stars may be found to satisfy the condition that PMS lies between the limits of 80° and 100°. On January 17, 1908, for instance, the date which happens to have been employed for purposes of illustration in the British Nautical Almanac, Aldebaran was even more favorably situated than Regulus, while a little later on Altair could be employed. The planets Mars and Jupiter might also have been

[2] If the small correction for a change of 3 in the value of the Proportional Logarithms, viz, 1", were applied to the two values first obtained, the three results would be practically identical. No correction for Second Differences is required in the Right Ascension process.

utilized, but in the case of the planets some little additional labor is involved in the correction of their elements.

It does not seem very extraordinary, now that the observation of a lunar distance is an occurrence of comparative rarity, that the authorities who control the Nautical Almanacs of the principal maritime nations should consider the calculation of distance tables hardly worth the trouble and expense involved, although in Germany, as in the United States, the tables are published as of old. Whether tables are provided or not the problem of longitude by lunar retains very considerable importance if only for occasional use, and in the interests of those who have not access to tables it is perhaps permissible to suggest a method of procedure somewhat shorter than that dependent on the actual calculation of two or three distances.

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CHANGE IN DEVIATION OF THE COMPASS DUE TO CHANGE IN TRIM.

By Lieut.-Commander Lloyd H. Chandler, U. S. Navy.

This investigation was undertaken to determine the effect upon the compass of a pronounced change in trim due to the flooding of a large compartment or of a number of compartments at one end of the ship, resulting in an abnormal trim, in which condition it might become necessary to work into port. The derivation of the change of trim equation follows similar lines to the derivation of that for heel, as given on page 131, *et seq*, Admiralty Manual, edition of 1901. In the case of change of trim, however, the problem is more complicated and the resultant equation less simple than for heeling, for reasons which will appear as the work progresses.

Let X, Y and Z represent, as they do when the deck is horizontal, the two first the components of the earth's magnetic force alone to head and to starboard, in the plane of the horizon, and the third the component vertically downward.

Let X_t and Z_t represent the components of the earth's magnetic force alone, the first to head in a plane parallel to the deck when inclined, and the second to keel when inclined, and let t represent the angle at which the deck is inclined to the horizontal due to the abnormal trim.

Let X'_t and Z'_t represent the components of the combined magnetic force of earth and of inclined ship, the first to head, in a plane parallel to the deck, and the second to keel.

Let X', Y' and Z' represent, with the ship down t degrees by the head, the components of the combined magnetic force of earth and ship, the first two to head and to starboard in the horizontal plane, and the third vertically downward.

Then we desire to obtain expressions for X', Y' and Z', in terms of X, Y and Z, when the ship is down by the head, which expressions will represent for the inclined condition what Poisson's equations do for the ship in the horizontal trim.

Poisson's equations are:

(1) $X' = X + aX + bY + cZ + P.$
(2) $Y' = Y + dX + eY + fZ + Q.$
(3) $Z' = Z + gX + hY + kZ + R.$

If now we rotate the ship about the horizontal, thwartships line through the compass, by dropping the bow, we get, by the ordinary rules for the transformation of equations under such conditions:

(4) $X_t = X \cos t + Z \sin t.$
(5) $Z_t = Z \cos t - X \sin t.$
(6) $X'_t = X_t + aX_t + bY + cZ_t + P.$
(7) $Y' = Y + dX_t + eY + fZ_t + Q.$
(8) $Z'_t = Z_t + gX_t + hY + kZ_t + R.$
(9) $X' = X'_t \cos t - Z'_t \sin t.$
(10) $Z' = Z'_t \cos t + X'_t \sin t.$

From (4), (5) and (6) we get:

(11) $X'_t = X \cos t + Z \sin t + aX \cos t + aZ \sin t + bY + cZ \cos t - cX \sin t + P.$

From (4), (5) and (7) we get:

(12) $Y' = Y + dX \cos t + dZ \sin t + eY + fZ \cos t - fX \sin t + Q.$

From (4), (5) and (8) we get:

(13) $Z'_t = Z \cos t - X \sin t + gX \cos t + gZ \sin t + hY + kZ \cos t - kX \sin t + R.$

From (9), (11) and (13) we get:

(14) $X' = X \cos^2 t + Z \sin t \cos t + aX \cos^2 t + aZ \sin t \cos t + bY \cos t + cZ \cos^2 t - cX \sin t \cos t + P \cos t - Z \sin t \cos t + X \sin^2 t - gX \sin t \cos t - gZ \sin^2 t - hY \sin t - kZ \sin t \cos t + kX \sin^2 t - R \sin t.$

From (10), (11) and (13) we get:

$$(15)\quad Z' = Z\cos^2 t - X\sin t\cos t + gX\cos^2 t + gZ\sin t\cos t + hY\cos t + kZ\cos^2 t - kX\sin t\cos t + R\cos t + X\sin t\cos t + Z\sin^2 t + aX\sin t\cos t + aZ\sin^2 t + bY\sin t + cZ\sin t\cos t - cX\sin^2 t + P\sin t.$$

Now in (14) and (15) substitute for $\cos t$ its value from

$$\cos^2 t = 1 - \sin^2 t$$

and we get—

From (14):

$$(16)\quad X' = X - X\sin^2 t + Z\sin t\cos t + aX - aX\sin^2 t + aZ\sin t\cos t + bY\cos t + cZ - cZ\sin^2 t - cX\sin t\cos t + P\cos t - Z\sin t\cos t + X\sin^2 t - gX\sin t\cos t - gZ\sin^2 t - hY\sin t - kZ\sin t\cos t + kX\sin^2 t - R\sin t.$$

From (15):

$$(17)\quad Z' = Z - Z\sin^2 t - X\sin t\cos t + gX - gX\sin^2 t + gZ\sin t\cos t + hY\cos t + kZ - kZ\sin^2 t - kX\sin t\cos t + R\cos t + X\sin t\cos t + Z\sin^2 t + aX\sin t\cos t + aZ\sin^2 t + bY\sin t + cZ\sin t\cos t - cX\sin^2 t + P\sin t.$$

Simplifying the above we get—

From (16):

$$(18)\quad X' = X + (b\cos t - h\sin t)Y + \{a - (c+g)\sin t\cos t - (a-k)\sin^2 t\}X + \{c + (a-k)\sin t\cos t - (c+g)\sin^2 t\}Z + P\cos t - R\sin t.$$

From (17):

$$(19)\quad Z' = Z + (h\cos t + b\sin t)Y + \{g + (a-k)\sin t\cos t - (c+g)\sin^2 t\}X + \{k + (c+g)\sin t\cos t + (a-k)\sin^2 t\}Z + P\sin t + R\cos t.$$

And from (18), (12) and (19) we get:

$$(20)\quad X' = X + \{a - (c+g)\sin t\cos t - (a-k)\sin^2 t\}X + (b\cos t - h\sin t)Y + \{c + (a-k)\sin t\cos t - (c+g)\sin^2 t\}Z + P\cos t - R\sin t.$$

$$(21)\quad Y' = Y + (d\cos t - f\sin t)X + eY + (d\sin t + f\cos t)Z + Q.$$

$$(22)\quad Z' = Z + \{g + (a - k)\sin t\cos t - (c + g)\sin^2 t\}X + (b\sin t + h\cos t)Y + \{k + (c + g)\sin t\cos t + (a - k)\sin^2 t\}Z + P\sin t + R\cos t.$$

These are of the form:

$$(23)\quad X' = X + a_tX + b_tY + c_tZ + P_t.$$
$$(24)\quad Y' = Y + d_tX + e_tY + f_tZ + Q_t.$$
$$(25)\quad Z' = Z + g_tX + h_tY + k_tZ + R.$$

Where

$$(26)\quad a_t = a - (c + g)\sin t\cos t - (a - k)\sin^2 t.$$
$$(27)\quad b_t = b\cos t - h\sin t.$$
$$(28)\quad c_t = c + (a - k)\sin t\cos t - (c + g)\sin^2 t.$$
$$(29)\quad d_t = d\cos t - f\sin t.$$
$$(30)\quad e_t = e.$$
$$(31)\quad f_t = d\sin t + f\cos t.$$
$$(32)\quad g_t = g + (a - k)\sin t\cos t - (c + g)\sin^2 t.$$
$$(33)\quad h_t = b\sin t + h\cos t.$$
$$(34)\quad k_t = k + (c + g)\sin t\cos t + (a - k)\sin^2 t.$$
$$(35)\quad P_t = P\cos t - R\sin t.$$
$$(36)\quad Q_t = Q.$$
$$(37)\quad R_t = P\sin t + R\cos t.$$

Now if λ_t, A'_t, B'_t, C'_t, D'_t, E'_t represent the altered values of λ, A', etc., we will have:

$$(38)\quad \lambda_t = 1 + \frac{a_t + e_t}{2} = \lambda - \frac{c + g}{2}\sin t\cos t - \frac{a - k}{2}\sin^2 t.$$

$$(39)\quad \lambda_t A'_t = \frac{d_t - b_t}{2} = \lambda A'\cos t - \frac{f - b}{2}\sin t.$$

$$(40)\quad \lambda_t B'_t = c_t\tan\theta + \frac{P_t}{H} = \lambda B' + \{(a - k)\sin t\cos t - (c + g)\sin^2 t - \frac{R}{2}\sin t\}\tan\theta - \frac{P}{H}\operatorname{versin} t.$$

$$(41)\quad \lambda_t C'_t = f_t\tan\theta + \frac{Q_t}{H} = \lambda C' + (d\sin t - f\operatorname{versin} t)\tan\theta.$$

$$(42)\quad \lambda_t D'_t = \frac{a_t - e_t}{2} = \lambda D' - \tfrac{1}{2}\{(c + g)\sin t\cos t + (a - k)\sin^2 t\}.$$

$$(43)\quad \lambda_t E'_t = \frac{d_t + b_t}{2} = \lambda E'\cos t - \frac{f + h}{2}\sin t.$$

Now if the soft iron be symmetrically arranged on each side of the midships fore and aft line, as we may assume to be the case, we have:

$$b = 0;\ d = 0;\ f = 0;\ h = 0;\ A' = 0;\ E' = 0.$$

Also if, as we may also assume, t be so small that its square and higher powers may be neglected, the

$$\sin t = t;\ \cos t = 1;\ \text{versin}\, t = 0;\ \sin^2 t = 0;$$

and we will have:

(44) $\lambda_t = \lambda - \frac{c+g}{2}\, t.$

(45) $\lambda_t A'_t = \lambda A'.$

(46) $\lambda_t B'_t = \lambda B' + (a - k)\, t \tan\theta - \frac{R}{z} t \tan\theta = \lambda B' + \left\{(a-k) - \frac{R}{z}\right\} t \tan\theta.$

(47) $\lambda_t C'_t = \lambda C'.$

(48) $\lambda_t D'_t = \lambda D' - \frac{1}{2}(c+g)t.$

(49) $\lambda_t E'_t = \lambda E'.$

Taking now the equation

(50) $\delta = A + B \sin z' + C \cos z' + D \sin 2z' + E \cos 2z'$, as is done in the deduction of the equation for heeling error, and substituting in it from the above, we get:

$$(51)\ \delta_t = \frac{\lambda A}{\lambda_t} + \frac{\lambda}{\lambda_t} B \sin z' + \frac{\left(a - k - \frac{R}{z}\right)t}{\lambda_t} \tan\theta \sin z' + \frac{\lambda C}{\lambda_t} \cos z' + \frac{\lambda D}{\lambda_t} \sin 2z' - \frac{1}{2\lambda_t}(c+g)\, t \sin 2z' + \frac{\lambda E}{\lambda_t} \cos 2z'.$$

Which becomes:

$$(52)\ \delta_t = \frac{\lambda}{\lambda_t}(A + B \sin z' + C \cos z' + D \sin 2z' + E \cos 2z') + \frac{1}{\lambda_t}\left\{\left(a - k - \frac{R}{z}\right)\tan\theta\right\} t \sin z' - \frac{1}{\lambda_t}\left(\frac{c+g}{2}\, t \sin 2z'\right).$$

Or:

$$(53)\ \delta_t = \frac{\lambda}{\lambda_t}\delta + \frac{1}{\lambda_t}\left\{\left(a - k - \frac{R}{z}\right)\tan\theta\right\} t \sin z' - \frac{1}{\lambda_t}\left(\frac{c+g}{2}\right) t \tan 2z'.$$

From (44) and (53), if the values of the parameters be known, we can determine the deviation resulting from a given change of trim. To further simplify, and put in more workable shape, however, we have:

$$(54)\quad \delta_t = \frac{2\lambda}{2\lambda-(c+g)t}\,\delta + \frac{2}{2\lambda-(c+g)t}\left\{\left(a-k-\frac{R}{z}\right)\tan\theta\right\} t\sin z' - \frac{2}{2\lambda-(c+g)t}\left(\frac{c+g}{2}\right) t\sin 2z'.$$

Or:

$$(55)\quad \delta_t = \frac{2\lambda}{2\lambda-(c+g)t}\,\delta + \left(\frac{2}{2\lambda-(c+g)t}\right)\left\{\left(a-k-\frac{R}{z}\right)\tan\theta\right\} t\sin z' - \frac{c+g}{2\lambda-(c+g)t}\, t\sin 2z'.$$

Now let:

$$(56)\quad G = \frac{1}{2\lambda-(c+g)t}.$$

And:

$$(57)\quad M = \left(a-k-\frac{R}{z}\right)\tan\theta.$$

And by substituting in (55) we get:

$$(58)\quad \delta_t = 2\lambda G\delta + 2GMt\sin z' - G(c+g)t\sin 2z'.$$

From a consideration of the above we see that we have caused the following changes in the deviation by changing the trim:

First. We have changed the value of λ, and have therefore changed the power of the compass to resist deviation. This change is represented by the term $\frac{2\lambda}{2\lambda-(c+g)t}\,\delta$, which shows that the change is caused by the c and g rods, and that the change varies with the degree of inclination. It is apparent from the normal position of the c and g rods that to incline them in a fore and aft direction results in the introduction of a new a rod, and in a change in the old values of c and g. The introduction of the

new a of course directly affects the value of λ, which is the directive force of the compass.

Second. We have introduced a new semicircular force involving the quantities G and M, which in turn depend, the first upon c and g, and the second upon a, k, R, Z and θ, and both upon the angle of inclination. Evidently the c rod, which originally caused semicircular deviation, will suffer change when inclined. Also the g rod, which caused no deviation when horizontal, will now act to produce such deviation, in other words will create a small resultant vertical (c) rod, which will cause semicircular deviation. Similarly a, when inclined, produces a resultant vertical rod, and likewise k, when inclined, produces a resultant vertical rod forward or abaft the compass. Also R, which formerly acted downward, and produced no deviation, now has its pole thrown forward or aft of the compass, causing a resultant pole in the horizontal plane, and produces semicircular deviation. It is evident at once that all these causes would properly produce a semicircular deviation, as indicated by their presence in the equation in the term involving sin z'.

Third. We have introduced a new quadrantal force, involving $G = \frac{1}{2\lambda - (c+g)t}$, $(c + g)$, and the angle of inclination. Plainly, the c and g rods, when inclined, not only produce resultant vertical rods with semicircular deviation, as described above, but also horizontal, fore and aft rods in the plane of the compass, or a rods, thus causing quadrantal deviation, as shown by their presence in the equation in the term involving sin $2z'$.

It is therefore clear that, by inclining the ship, as she changes trim:

The c and g rods produce a resultant a rod, modify the value of the existing c rod, and affect the semicircular and quadrantal deviations, and the value of λ.

The a and k rods produce a resultant c rod, modify the value of the existing a rod, and affect both semicircular and quadrantal deviations, and the value of λ. The change in the a rod, however, is not sufficient to affect the quadrantal deviation, and it disappeared from the quadrantal term of the equation accordingly. See equation No. (42).

The R force changes its effect, its pole shifting its position relative to the compass, and becoming active in the horizontal plane to produce semicircular deviation, P and Q theoretically act in a similar way, but their change is so small as to be negligible, under our assumptions, and they accordingly disappear from the equations.

It may also be noted that these changes are all caused by the inclination of rods in the fore and aft vertical plane, in other words by changing the position of horizontal fore and aft rods and vertical rods relative to the inducing forces that act upon them, namely H and Z. As Z acts equally on every heading, its effect will not change with change of heading, while the effect of H will show as a maximum on north and south, and disappear on east and west. This does not mean that the total change will be a maximum on north and south and a minimum on east and west, however, for this would only be the case when the effects of H and Z both act in the same direction, and in other cases they would counteract each other, and the maximum combined effect would be on east and west headings.

The following table shows the practical results of change of trim in a supposed case:

Take as data:

Lat. 30° 00′ North.	$\lambda = .8.$
Long. 40° 00′ West.	$a = +.02.$
$\delta = 60°.$	$k = -.03.$
$Z = 2.25.$	$c = +.09.$
	$g = +.02.$
	$R = +.02.$

Then we have:

$$G = \frac{1}{1.6 - .11t}.$$

$$M = +.071.$$

The following table gives the results for the above ship, in that position on the earth's surface, for various headings and angles of change of trim. In giving the amount of submergence of the bow for any given angle of inclination, the ship is supposed to pivot in inclining about a point 300 feet from her bow. Her length is supposed to be 450 feet. For these conditions we have that, to

get the required angle of inclination, the bow would have to sink as follows:

For $t = 1°$ the bow goes down 5.2 feet.
" $t = 2°$ " 10.4 "
" $t = 3°$ " 15.7 "
" $t = 5°$ " 26.1 "
" $t = 10°$ " 52.1 "

The results are:

Ship's head by by compass Z'	Deviation when horizontal δ	Deviation when inclined by the head				
		$t = 1°$ δ_t	$t = 2°$ δ_t	$t = 3°$ δ_t	$t = 5°$ δ	$t = 10°$ δ_t
N	+1°	+1.08°	+1.16°	+1.26°	+1.52°	+3.20°
NE	0	−0.01°	−0.01°	−0.02°	−0.04°	−0.19°
E	−1°	−0.98°	−0.95°	−0.92°	−0.84°	−0.36°
SE	−3°	−3.23°	−3.47°	−3.76°	−4.52°	−9.41°
S	−2°	−2.16°	−2.32°	−2.52°	−3.04°	−6.40°
SW	+1°	+0.93°	+0.85°	+0.76°	+0.52°	−1.01°
W	+3°	+3.14°	+3.27°	+3.44°	+3.88°	+6.76°
NW	+2°	+2.17°	+2.33°	+2.53°	+3.07°	+6.59°

In the case under consideration it therefore appears that no probable ordinary change of trim would introduce any material error. It is believed that a similar investigation for each ship of the fleet, using formulæ (56), (57) and (58) would be of sufficient interest to pay for the time it would take, and perhaps in some cases values might be obtained of sufficient magnitude to make it necessary to consider them in actual practice. It will be noted that, the larger the horizontal deviations, the greater will be the actual error in degrees introduced by change in trim.

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A SHORT ACCOUNT OF LEGISLATIVE ACTION IN REGARD TO THE UNITED STATES NAVY UP TO THE WAR OF 1812, AND NOTES CONCERNING THE HISTORIES OF NAVAL VESSELS DURING THAT PERIOD.

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The strained relations resulting from British oppression in the American Colonies, induced measures of retaliation and of violence which were first exhibited in the sea-coast towns and which immediately affected the maritime personnel and materiel. The earliest nautical expeditions directed against the common enemy were those of armed vessels of Massachusetts, Rhode Island and Connecticut, sent out to intercept and capture military supplies which were then such an absolute necessity to the Continental army.

Washington at once followed this example by granting commissions to privateers. The first nautical enterprise of moment which followed the battle of Lexington was the cutting out of the Crown schooner *Margaretta* at Machias, Maine, May 9, 1775; later occurred the *Gaspee* affair, August 26, 1775.

These examples were the forerunners of the first order from a central body, the Continental Congress, authorizing and directing public operations at sea, in which Congress directed Washington, October 5, 1775, to apply to the council of Massachusetts for two armed vessels to put to sea and to intercept supplies sent from England to Quebec. This resolution also authorized Washington to "employ" other vessels if he judged it to be necessary. Among the few vessels thus used, the *Lee*, a Massachusetts vessel under command of Captain Manley, was by far the most noteworthy. "Although it may not be strictly true to term the *Lee*

and other small State cruisers similarly employed the first vessels that ever belonged to the general government of this country, they may be deemed the first that ever actually sailed with authority to cruise in behalf of the entire republic. But, while we accord this precedence to Captain Manley and his associates who acted under the orders of Washington, Congress itself had not been altogether idle, and it is probable that the commander-in-chief took the step just mentioned in accordance with the expressed views of that body." Manley put to sea in the *Lexington* from Marblehead late in November, 1775, and, a few days later, on the 29th, captured the British brig *Nancy* loaded with military stores.

The first thought of a Colonial Navy originated in Rhode Island. In September, 1775, the two houses of legislature of that colony concurred in ordering their representatives to Congress to propose the establishment of a navy "at the expense of the Continent." On October 3, the attention of Congress was called to this matter but the minutes of proceedings of the day fail to record any favorable action and it is probable that little attention was paid to the suggestion. However, on Friday, October 13, Congress authorized the procuring of two vessels of 10 guns, to be equipped as national cruisers. This was the first legislative act of Congress on the subject of the navy and resulted in the purchase of the brig *Lexington* 14, which was captured by the British *Alert* September 1777, and the sloop *Providence* 12, which was destroyed in the Penobscot river expedition in 1779. Messrs. Deane, Gadsden and Langdon were the committee appointed to select these vessels.

On October 29, 1775, a resolution was adopted denying the right of private vessels to fly a pennant in the presence of public vessels, and on the 30th, a law was passed authorizing the fitting out of two more cruisers, one of 36 guns and one of over 20. On November 2, Congress placed $100,000 with the marine committee to buy and equip vessels at once, and under this provision the following vessels were obtained:

The *Black Prince*, an old merchantman, was purchased to become the *Alfred* 20, 9-pounders, the flagship of the new fleet and a vessel which did good service until captured by the British *Ceres* and *Ariadne* March 9, 1778.

A merchant vessel named the *Sally* became the *Columbus* 18, which was in service at the end of the war.

The *Andrew Doria* 14 was a purchased brig and had the honor

of the most successful cruise of these early vessels and was finally burned to prevent falling into the hands of the British on the evacuation of Philadelphia in September, 1777.

The *Cabot* 14, later 16, was another converted brig. After an unimportant career she was chased ashore on Nova Scotia by the British liner *Milford* and abandoned. She was later got off and commissioned in the English service.

The ***Hornet*** 10 was a purchased sloop equipped at Baltimore. Her fate is unknown, but she was supposed to have been burned in the Delaware river to prevent her capture by the British.

A schooner which became the *Wasp* 8 served in the Delaware river and was burned there in 1777.

A small schooner, the *Fly* 8, was procured for use as a dispatch vessel.

On November 10, 1775, Congress authorized and provided for the establishment of the Marine Corps. On November 25, legislation was adopted authorizing the issuing of commissions to colonial and privateer officers. Congress adopted, November 28, the first "rules for the regulation of the Navy of the United Colonies"; comparatively little of importance was embraced in the foregoing. On December 2, Congress voted $500,000 additional to defray expenses. The first regular cruisers to get to sea under orders from the new government were the *Hornet* 10, and the *Wasp* 8, a sloop and a schooner equipped at Baltimore by the marine committee, and which sailed in November to join Commodore Hopkins in the Delaware. This was a passage, hardly a cruise.

Congress appointed a committee, December 11, 1775, to draw up a report looking to the building of regular men-of-war. This board submitted its report two days later and Congress at once authorized the construction of 13 frigates, properly apportioned to the various colonies. Their names and brief histories are as follows:

The first of these vessels to get to sea was the *Randolph* 32. She was launched in 1776, about 10 months after her keel was laid at Philadelphia, and sailed on her first cruise early in 1777 under command of Nicholas Biddle, doing good service until her unfortunate but heroic destruction by the British line-of-battle ship *Yarmouth* 64, March 7, 1778. This action should be properly regarded as one of the bravest and proudest exploits of our navy.

It was also the first combat fought by a government-built and equipped vessel.

The *Trumbull* was a small 32-gun cruiser built by Connecticut; she got to sea in February, 1777, and on April 9 captured two transports. Her first commanding officer was Dudley Saltonstall. While under command of Samuel Nicholson in August, 1781, she was dismasted by a gale and while helpless forced to strike to the British frigate *Iris,* which vessel was herself the captured *Hancock.*

The *Hancock* 32, was built in Massachusetts and sailed on her maiden cruise under command of Captain Manley, of *Lee* fame, early in May, 1777. She was a large vessel and made several captures, but was taken in 1781 by the British *Rainbow* 44, and *Victor* 18, and entered their service as the *Iris.*

The *Raleigh* 32, sailed from Portsmouth, N. H., in August, 1777. Captain Thompson, who had sailed in the *Alfred,* commanded her and in her executed several daring maneuvers, notably the cutting out of several merchantmen under convoy. In September, 1778, this vessel sailed from Boston, Captain Barry in command, and within a few days met the British *Experiment* 50 and *Unicorn* 22, was dismasted while trying to escape and driven ashore in Penobscot bay. She was fired and abandoned, but a British landing party succeeded in extinguishing the fire, and she was hauled off and placed in their service. This vessel was launched within 60 days of her commencement.

The *Boston,* a small frigate of 24 guns, was built by Massachusetts. She got to sea early in 1777 but was a poor sailer and was rather unlucky. She was captured by the British at the fall of Charleston, 1780.

The *Warren* was built by the colony of Rhode Island. She was a 32-gun frigate and did not get to sea until April 18, 1778, under command of Captain Hopkins. She was the largest American vessel of her time; she captured eight vessels and was finally destroyed in the Penobscot river in July, 1779, while Saltonstall's flagship. She was not a well built vessel.

The *Providence* 28, was also built in Rhode Island; she made one of the most profitable cruises of the war with Captain Whipple but was considered a poorly constructed vessel. She was captured by the British at the fall of Charleston in 1780.

The *Virginia* 28 was built in Maryland. In attempting to get

past the British blockade, March 30, 1778, under command of Samuel Nicholson, she got aground within 12 hours after her first departure from her port of building and was captured by the enemy and later commissioned in the English service.

The *Washington* 32, the *Effingham* 28, and the *Delaware* 24 were Pennsylvania built vessels and were particularly unfortunate. At the time of the British occupation of Philadelphia (September, 1777) these vessels were not completed and an expedition was at once sent up the river, where they had been withdrawn for safety, to capture them. The *Washington* was never armed or completed and was at once burned by the enemy. The *Effingham* was placed under command of Captain Barry, hastily and wretchedly equipped, and made a rather successful fight, but was finally captured and burnt. The *Delaware* had been almost completely fitted out and her capture at this time was a serious loss. The New York vessels, *Congress* 28 and *Montgomery* 24, built at Poughkeepsie, were removed up the Hudson in an uncompleted condition and destroyed in 1777, when Sir Henry Clinton obtained possession of the Highlands, to prevent their falling into his hands.

Congress passed resolutions on December 22, 1775 commissioning one commander-in-chief, four captains, five first lieutenants (of whom Jones was one), 5 second lieutenants and three third lieutenants. The pay of the commander-in-chief was placed at $125 per month and the position was intended to compare in rank with that of Washington ashore. The incumbent was designated by his subordinates as commodore. The equipment of the first vessels ordered by Congress progressed slowly and it was not until about the end of December that a small squadron was ready for commissioning, at which time, the exact day is unknown, Hopkins as commander-in-chief took command, with the *Alfred* as flagship, at Philadelphia and, probably on the same day, caused the first American flag to be hoisted, an honor which was performed by John Paul Jones. It is not known definitely what the device of this flag was, but it is presumed to have been a white flag with a rattlesnake in 13 pieces shown, underneath which were the words, "Don't tread on me." It is possible, however, that a liberty cap and the words, "An appeal to Heaven," or the old pine tree flag, may have been the insignia shown. It was not until June 14, 1777, that the present flag scheme was adopted. This flag had 13 alternate red and white stripes and a blue union contain-

ing 13 white stars. On January 13, 1794, Congress altered the flag to 15 stripes and 15 stars, the stars arranged in a circle. The present flag was created by act of Congress of April 4, 1818, which required the flag to have 13 stripes and 20 stars in a blue field, with the addition of another star on and after July 4 of the year in which a new State was admitted. A second flag called "the grand union of the colonies," made with 13 red and white stripes in the field and having the British jack as a union, was also flown from the *Alfred* in addition to a flag designating the flagship.

The first regular cruise of vessels of the navy was made by Hopkins with the *Alfred, Columbus, Doria, Cabot, Providence, Hornet, Wasp* and *Fly*, which vessels got to sea February 17, 1776, bound for the island of Abaco in the Bahamas. Here, after some resistance, they possessed themselves of considerable military stores, the marines rendering excellent service in the landing parties. The principal action was fought March 10, the *Wasp* and the *Providence* covering the landing. On March 4, the fleet captured the British tender *Hawke* 6, and on the 5th, the bomb brig *Bolton* 8; these were the first prizes captured by public vessels. The next vessel captured was the English brig *Edward* 8, made by the *Lexington*, Captain Barry, April 17. This is often erroneously spoken of as the first American naval capture. Returning to the coast Hopkins's fleet engaged in a running fight with the British ship *Glasgow* 20. This vessel fought with great gallantry which, combined with the lack of co-operation amongst our vessels, enabled her to escape. A bitter investigation which followed this affair led to the revocation of the position of commander-in-chief, a title never again held by a naval officer, although an attempt was made some years later to pass a bill to restore it, but without success. A serious outbreak of small-pox occurred in this fleet during its return, the *Doria* especially suffering.

The first naval operations in inland waters were the actions off Valcour Island, Lake Champlain, October 11 and 13, 1776, in which a hastily prepared fleet of 17 small vessels under command of Brig.-General Benedict Arnold engaged and fought two practically drawn battles with a British fleet of somewhat superior strength. This action has been termed "the naval Bunker Hill," and showed the English commander, Sir Guy Carleton, such stubborn resistance and such a quality of endurance that he retired at

once to Montreal for the winter instead of forcing his way to the coast, making a junction with the troops on the sea coast and thus dividing the colonies, an attempt which was afterwards made, with somewhat similar results, by Burgoyne.

Congress on October 3, 1776, ordered another frigate and two cutters and on November 9, authorized the construction of three line-of-battle ships of 74 guns, five frigates, one sloop-of-war and one packet. Eight prizes were taken into the service at this time, also "divers" small vessels built and purchased. During the year 1776, Congress in many ways neglected the navy and failed to make adequate and obvious provision for this branch of public defence. The personnel and discipline became wretched and comparatively little use was made of vessels beyond carrying diplomatic representatives to Europe and the transportation of stores. This period of naval depression ceased on the advent of the thirteen regular vessels built by the country.

By the latter part of 1776 the *Reprisal* 16, the first vessel to carry the American flag into the other hemisphere, was added. This vessel took many prizes and foundered off the coast of Newfoundland during the fall of 1777.

The *Hamden* (not the privateer *Hampden*), a vessel of 14 guns, was one of the few vessels which remained in service at the end of the war.

The following vessels appeared during and subsequent to this time: The *Sachem* 10 and *Independence* 10 were small vessels built and used in the Delaware river where they were destroyed to prevent falling into the hands of the enemy after the evacuation of Philadelphia. The *Dolphin*, a cutter of 10 guns, got to sea in April, 1777, and did excellent service in the English channel. The *Surprise*, an English built cutter, was bought by our agents in France. This vessel and the *Revenge*, both commanded by Connyngham at different times in 1777, caused great havoc amongst the enemy's shipping in the channel. The occupation of Philadelphia and the regrettable loss of naval vessels there caused Congress to exert itself in obtaining vessels at other places, thus there was little activity at sea during the latter part of 1777.

The *Alliance* 32, named in honor of the then popular French alliance, was built at Salisbury, Mass., in 1778. She was a beautiful and fast ship and her command, another favor to France, was given to Capt. Pierre Landis, a French naval officer. She left for

Brest January 11, 1779, having a wretched crew, many being Englishmen from the recently wrecked liner *Somerset*. During the passage the only mutiny to assume serious proportions in the history of our navy occurred and was with much difficulty quelled. Lafayette was a passenger on board at the time. The part this vessel played in Jones' glorious fight with the *Serapis* and *Countess of Scarboro* while still under the command of this probably insane and untrustworthy Frenchman is one of the most unprecedented and unfortunate in our annals. She was a very fast vessel, having logged 15 knots, and was always popular; was sold to become an Indiaman; was the first vessel to carry our flag to China and was finally broken up in the Delaware river.

The *Confederacy* 32 was launched at Norwich, Conn., in 1778 and sailed for Europe in 1779 with Mr. Jay, Minister to Spain, on board. She was dismasted off Bermuda and the minister continued his voyage in another vessel. She struck to a liner and a frigate of the enemy June 2, 1781.

The *Deane* 32 (afterward called the *Hague*) was first commissioned during the summer of 1779. Among other exploits she escaped by brilliant seamanship from a vastly superior force and remained in service at the end of the war. She was later sold and became an Indiaman.

The *Queen of France*, a name also indicative of the popular feeling in regard to that country, sailed on her first and only cruise April 18, 1779, during which, with the *Warren* and *Ranger*, she captured eight prizes. This vessel was captured by the British at the fall of Charleston in 1780.

The *Ranger* sloop 18, built at Portsmouth, N. H., 1776-78, sailed for Brest April 10, 1778, under command of John Paul Jones, who unfortunately could obtain no larger ship at the time. She was a crank and slow vessel, although the glory she achieved under her intrepid commander and her action with the *Drake* places her name among the highest. She was captured at Charleston in 1780.

The *Bon Homme Richard* 40 should without doubt stand at the head of any list of distinguished American naval vessels, an inspiration to present and future generations. This ship was a clumsy and ancient French Indiaman which happened to be lying at L'Orient in February, 1779, at which time she was turned over to Jones by orders of the King of France who, having promised Jones a vessel and finding it impossible to spare a man-of-war,

authorized the transfer. Many alterations were made on this old vessel and her name changed from *Duras* to *Bon Homme Richard*, a compliment to Franklin. Her decks were strengthened, ports cut and a battery, chiefly of discarded French guns, added. The equipment and battery were far from satisfactory to Jones but, harassed by diplomatic troubles and many annoyances, he finally sailed, having a crew of 380 men, 243 being seamen and 137 a French marine guard. This vessel engaged the British frigate *Serapis* 44 and *Countess of Scarboro* shortly afterward and fought what was unquestionably the most brilliant and resourceful action in our naval history.

The French ministry also added to our roster three small vessels, the *Pallas* and *Cerf*, cutters, and the brig *Ariel* 20, which were of use in harrying the local shipping of the enemy. It is probable that private adventure and greed were at the bottom of this outfitting and not an absolutely disinterested government policy.

The *Diligent* 12 was captured from the enemy in the spring of 1779 and taken into our service; she was later destroyed in the Penobscot in July, 1779.

In November, 1776, the *America*, the only line-of-battle ship of the class authorized by act of Congress November 9, was commenced. She was launched November 5, 1782. The progress of this vessel's construction was slow; little work was done on her until May, 1777, and she was six years in building. Her length was 183 feet, beam 50½, depth of hold 23, displacement 1982 tons. The battery comprised thirty long 18's, thirty-two long 12's, and fourteen long 9's; her complement was estimated from 626 to 720 men. John Paul Jones superintended the latter part of her construction and was to have commanded her, but at the last moment the ship was presented to the King of France to compensate for the loss of the French *Magnifique* 74, which was wrecked during the summer of 1782 in Boston harbor, it is said through the carelessness of a local pilot. The *America* had been constructed of green unseasoned timber and rapidly becoming unseaworthy, was broken up in Brest during the latter part of 1786 and her name given to a new ship. This vessel was not captured by the British in the battle of June 1, 1794, as is often stated.

Peace established in 1783 found the country practically stripped of a navy. In 1785 the last remaining frigate, the *Alliance*, was

sold, as there was no money in the treasury for her repairs and for eight years there was no navy. In 1789 the Articles of Confederation were superseded by the Constitution and Washington became President and consequently commander-in-chief of both army and navy. Although discussed, it was thought premature to re-establish a navy. The acts of piracy of the Dey of Algiers, beginning during July, 1785, made it apparent that public armed vessels were needed and, although these depredations continued, reasons of policy prevented measures of retaliation for some time. In 1792, John Paul Jones was appointed a special agent to negotiate for the release of American captives. He was dead when the commission arrived and Barclay was appointed in his stead, and also died before anything was accomplished.

In 1793, Portugal and Algiers declared peace and the Dey at once turned his almost undivided attention to capturing and annoying American commerce, and shortly after captured 10 additional vessels and imprisoned 105 more of our countrymen.

On March 3, 1794, the President sent a message regarding these matters to Congress and on March 27, a law was passed authorizing the construction of six frigates, no vessel to be below 32 guns; the act, however, contained a clause stating that in the event of cessation of hostilities with Algiers, its provisions should cease.

Under this act these vessels were laid down: *Constellation* 38, at Baltimore; *Congress* 38, at Portsmouth, N. H.; *President* 44, at New York; *Constitution* 44, at Boston; *United States* 44, at Philadelphia; *Chesapeake* 38, at Portsmouth, Va.

In November, 1795, a treaty of peace was negotiated with Algiers and all work on these vessels ceased. The President called attention to this state of affairs and a new act was passed in 1796 allowing the completion of two of the 44's and one of the 38's. This peace with Algiers cost our government over one million in money and much tribute, as presents; among these was the frigate *Crescent*, which had as a part of her cargo 26 barrels of dollars.

At this time the French military supremacy began to be felt and the depredations practiced by her navy towards the English were also extended to our growing merchant marine. Protests were in vain, and in April, 1798, the Secretary of War recommended the authorization of the building of 20 small vessels and, in the event of actual war, six ships of the line, in addition to com-

pleting the six frigates authorized in 1794. Of these latter vessels the three first finished were the *United States*, which got afloat July 10, 1797, at Philadelphia; the *Constellation*, which was launched September 7, at Baltimore; and the *Constitution*, at Boston, September 20. The latter would have been the first afloat but for an accident which caused her to stick on the ways.

The *United States* got to sea in July, 1798, and did excellent service, perhaps the most noteworthy being the capture of the British frigate *Macedonian* on Sunday, October 25, 1812. The latter part of her existence was passed as a receiving ship and she was finally destroyed at Norfolk upon the evacuation of the navy yard in 1861.

The *Constellation*, the second ship of the new navy afloat, also required a year to commission. This vessel took a leading part in the French embroglio and captured *L'Insurgente* 36, which was taken into the service under the same name and was lost at sea in July, 1800. The *Constellation* is still in the service as a receiving ship.

The *Constitution* bears the name probably best known to our history; no other ship except the *Bon Homme Richard* can share in her well-earned reputation for success and brilliant achievement; the former vessel had, however, a far larger career. Her magnificent escape from a British fleet July 17, 18, 19, 1812, was a marvel of seamanship. Her actions with the *Guerriere* August 15, 1812; with the *Java* December 26, 1812; and with the *Cyane* and the *Levant* in February, 1815, are among the most memorable and creditable of our service. The *Constitution*, although entirely rebuilt about 1836, is still afloat at Boston.

The advice of the Secretary of War in April, 1898, concerning the building of new ships was so far adopted by Congress that the President was authorized to " build, buy or hire " 12 vessels, none to exceed 22 guns, and to duly equip them; for this purpose $950,000 was appropriated.

On April 30, 1798, the Navy Department was established and Benjamin Stoddert, of Georgetown, D. C., became the first Secretary. The various legislative bodies having control of the affairs of the navy may now be summarized as follows:

On October 13, 1775, naval affairs were placed in the hands of the " marine committee," which consisted at first of Deane, Langdon and Gadsden.

December 14, 1775, the marine committee was increased to contain one member from each colony. To this committee extensive powers were given.

In November, 1776, a "continental navy board" was established as a subordinate to this committee, and three members, Nixon, Wharton and Hopkinson, were appointed. Of these two divisions the former was termed "the eastern board," and the latter "the board of the middle district."

On October 28, all this was changed and a "Board of Admiralty" was established, consisting of three members who were not in Congress and two who were; any three were empowered to act.

In January, 1781, James Reed was appointed by resolution to manage the affairs of the "navy board" in the middle department, and on February 7, 1781, Alexander McDougall, a major-general in the army and who had never been at sea, was chosen "Secretary of Marine."

In August, 1781, the entire system was again changed by the appointment of an "agent of marine" who had full control of the service, only subject to Congress. He superseded all boards, committees and agents. Here the legislation on this branch of the government closed for some time. This "agent of marine" was subsequently the "superintendent of finance" in addition to his other duties, and later Secretary of War. It was thus for some time that Robert Morris had more to do with the navy than any other civilian in the country.

On August 7, 1789, the War Department formally took over all matters concerning the navy hitherto not under its jurisdiction.

On April 30, 1798, a Navy Department was established.

On February 15, 1815, the President, with the advice of Congress, established as aids to the Secretary of the Navy a "board of navy commissioners" composed of Captains Porter, Hull and Rogers. This system held until 1842, when the bureau system was inaugurated with five bureaus. In 1862 three additional bureaus were added and later an assistant secretary allowed.

On May 4, 1798, Congress made appropriation for several small vessels known as galleys and on the 12th, the President was empowered to instruct the commanders of public vessels to capture French ships. In June another law was passed allowing the Presi-

dent to "accept" 12 more vessels, should they be offered by citizens, and to pay for them in public stock. It was also provided that these vessels should be limited in gun power to six of not over 18 guns, twelve not over 24, and six not less than 32. A strong reluctance was at this time again shown to creating a permanent and powerful armed force.

On July 11, 1798, a new marine corps was organized, the old one having been totally disbanded. It was to be composed of 881 officers and men commanded by a major.

On July 16 a law was passed allowing three more frigates to be constructed. This was to, and did allow the completion of the three frigates *President* 44, *Chesapeake* 38 and *Congress* 38, the completion of which was suspended by the law of 1796. Several small sloops, galleys and cutters were also authorized; in all, 39 vessels. The work on these ships progressed very slowly.

The *Ganges* 24 was bought at this time and her name retained. She was the first vessel to get to sea under the new Navy Department. Richard Dale, of *Bon Homme Richard* fame, took her to sea May 22, 1799. She captured many French prizes and was sold out of the service March 4, 1801.

The *Delaware* 20 was bought and went to sea under command of Decatur in June, 1798. Her greatest service was the capture of the French *LeCroyable*, which was brought into the service under the name of *Retaliation*. This was the first vessel taken by the navy under its present form. The *Delaware* was sold March 4, 1801.

At the end of 1798 the following vessels were in service:

United States	44	*South Carolina*	12
Constitution	44	*General Greene*	10
Portsmouth	24	*George Washington*	24
Norfolk	18	*Ganges*	24
Pinckney	18	*Merrimac*	24
Pickering	14	*Montezuma*	20
Eagle	14	*Baltimore*	20
Scammel	14	*Delaware*	20
Governor Jay	14	*Harold*	18
Virginia	14	*Richmond*	18
Diligence	12	*Retaliation*	14

The first 13 of these vessels were built especially for the navy, and the latter nine were purchased merchant ships. The arma-

ment of these early men-of-war was rather light. Long 9's and 6's were the common arm for small vessels, and frigates seldom carried heavier than 12's and 9's. The short smashing gun called the carronade, from the town of Carron in Scotland where they were first cast, had not been adopted at this time. The British as well as the French had been surprised by the sudden appearance of United States vessels at sea. This activity was not confined to the navy. Two frigates and five large sloops were building by popular subscription to be used as privateers, and soon many of this latter class had taken the sea. While English naval officers at sea at first treated our new navy with sufficient cordiality, relations soon became strained, owing chiefly to the unjust and iniquitous British custom of impressing men, not only from United States merchant vessels but from our armed public vessels as well, the continuance of which custom was the direct cause of the war of 1812, which soon followed. In November, 1798, Captain Phillip of the *Baltimore* had men taken from him, by impressment by a British fleet, for which he was dismissed.

By the end of the year 1799 the following vessels had been added:

Essex	32	*Boston*	28
John Adams	28	*Adams*	28
Connecticut	24	*Patapsco*	20
Maryland	20	*Warren*	18
Augusta	14	*Enterprise*	12

and several revenue cutters and galleys.

In the year 1800 the following vessels were added:

President	44	*Chesapeake*	38
Philadelphia	38	*New York*	36
Insurgente	32	*Trumbull*	24

The *Enterprise* 12 was a favorite and fortunate vessel and made one of the most brilliant and useful cruises ever sailed under the flag.

Peace with France was ratified February 3, 1801, and again the old cry of extravagance was raised against the navy, and the legislative body showed its opposition to a permanent armed naval force by giving to the President discretionary power, to be used when he deemed proper, to sell any or all vessels of the navy except 13 specified frigates, and also to reduce the personnel.

In accordance with this power all vessels except the following were sold March 4, 1801:

Constitution	44	*United States*	44
President	44	*Congress*	38
Constellation	38	*Chesapeake*	38
Philadelphia	38	*New York*	36
Essex	32	*General Greene*	28
Boston	28	*Adams*	28
John Adams	28		

These vessels were ordered by Jefferson to the navy yard, Washington, where he intended (1802) to build a huge dry dock large enough to house 12 frigates; he was not, however, supported by Congress.

In all, twenty vessels of 12 to 24 guns and nine galleys were sold. $500,000 was appropriated for completing the six 74's voted in 1798 and for navy yards and wharves.

National peace was, however, at this time of short duration. In May, 1800, Bainbridge left the United States in the frigate *George Washington* 24, to carry tribute to the Dey of Algiers; upon his arrival he was compelled, having anchored under the guns of the fort, to carry, as a vassal, a message to the Sultan at Constantinople. Although deeply humiliating to our national honor, no action was taken of the affair at the time.

On May 14, 1801, the Bashaw of Tripoli declared war against us. Captain Dale was ordered to hoist his broad pennant on board the *President* and, with the *Philadelphia, Essex* and *Enterprise,* appeared in the Mediterranean in September.

This war was terminated by treaty of peace signed June 3, 1805. While no great actions are to be recorded concerning this war, the whole management and conduct was prosecuted with the greatest energy and credit.

The recapture and burning of the *Philadelphia* February 16, 1804, which vessel had unfortunately grounded and been taken October 31, 1803, brought forth from Nelson the praise that it was the most brilliant naval feat of the age.

The daring and courage of Somers, who, probably deliberately, blew up his own vessel, the *Intrepid,* September 4, 1804, a fire ship intended for the destruction of the enemy's shipping, rather than allow her to be captured, is difficult to equal and impossible to excel.

The *New York*, an old vessel, was very nearly destroyed by fire while in the Mediterranean at this time.

The *John Adams*, a small vessel which had twice been decked over as a frigate and which had also twice had this deck removed, converting her into a sloop of war, served during this war as did also the *Adams, Chesapeake, Constellation, Argus, Syren, Nautilus, Vixen* and *Hornet*.

During the summer of 1802 Congress laid down some light cruisers and in February, 1803, authorized two brigs and two schooners. They were ready for service by the spring of the same year and were the schooners *Nautilus* 18 and *Vixen* 12, and the brigs *Argus* 16 and *Syren* 16.

All of these vessels were finally captured by the enemy during the war of 1812. The *Argus*, built at Boston, was captured by the British brig *Pelican* August 14, 1813; the *Nautilus* and the *Vixen* both built at Baltimore, were captured in 1812, and the *Syren*, built at Philadelphia, was captured by a 34 of the enemy in the following year.

There was no new legislation in regard to the navy during the year 1806. The evils and injustice of British impressment as practiced against our merchant and even naval vessels had steadily increased and had brought the two nations to the verge of war, and were the cause, on June 22, 1807, of the most humiliating and painful event in our naval history. On that day the *Chesapeake* left the Norfolk navy yard bound for the Mediterranean and was stopped off the Capes of Virginia by a ruse of the British frigate *Leander* 50, boarded, and upon the refusal of Captain Barron, her commanding officer, to surrender alleged English deserters, was fired into for fifteen minutes. The *Chesapeake* had but recently been placed in commission and the confusion and disorder, although not to be excused, was great. Only one gun was fired and that by a coal carried by a lieutenant in his fingers from the galley. Captain Barron, seeing his men needlessly killed, hauled his flag down to the rail, whereupon the *Leopard* took the men in question from her and sailed away.

Protests were made by this government but practically without avail. The sentiment of the country was not unanimously in favor of war. The weakness of our resources and the commercial inclinations of a section of the country for a time stifled efforts to retrieve our national honor and to liberate about 20,000 American

seamen held in unlawful and unjustifiable service in English vessels.

About this time, 1804-1807, the so-called "gunboat policy" of Jefferson was inaugurated. It has been variously called a "blunder and misdirection of national resources" and a "ridiculous plaything." These small vessels were of the following average dimensions: Length, 60 feet; beam, 17; depth, 6. They carried one or at most two guns of 24- or 36-pounder weight. Several of these miniature craft actually crossed the Atlantic during the Tripolitan war and some few were used during the war of 1812, but as a class they were useless. Fifteen of these vessels were appropriated for in 1803; in 1805, 25; in 1806, 50; and in 1807, after the *Chesapeake* affair, 188; only 176, however, were ever actually built.

In 1808 two vessels were built for service on Lake Champlain, and one, the *Oneida* 16, for Lake Ontario.

In February, 1809, the President was directed to re-equip the *President* 44, *Essex* 32, and *John Adams* 24. The marine corps was augmented 700 men, but no new building commenced. In April of this same year, however, by a vote of 60 to 30, Congress voted to reduce the navy to three frigates and three small craft, to discharge all officers and men not necessary to man these vessels, to discontinue the navy yards at Portsmouth, N. H., Philadelphia and Washington, and to decrease the marine corps to two companies. After much discussion as to the exact wording of this reduction the bill was finally dropped. The Congress which was in session from November, 1811, until July, 1812, while aware of the necessity of a greater naval force to meet the impending war, could not pass any measure looking toward this end. During the summer of 1811 we had in active service the following vessels:

President	44	*Hornet*	18
Constitution	44	*Argus*	16
United States	44	*Syren*	16
Essex	32	*Nautilus*	12
John Adams	28	*Enterprise*	12
Wasp	18	*Vixen*	12

March 30, 1812, Congress authorized the President to construct three additional frigates and appropriated $200,000 annually for the purchase of timber for new ships and for the rebuilding of the *President, New York, General Greene* and *Boston.*

Congress took no other action of moment concerning the navy during the year 1812, although war was declared with Great Britain in June, and it was not until January, 1813, that Congress voted, against strong opposition, $2,500,000 for the building of four ships of the line, 74's, and six frigates, and after such examples of our naval ability to handle vessels of war as the actions between the *Constitution* and *Guerriere*, the *Wasp* and the *Frolic*, the *United States* and the *Macedonian*, and the *Constitution* and the *Java*.

In January, 1812, the total number of the enlisted personnel amounted to 4000; the marines, 1800; naval officers 494, including 400 midshipmen and 38 marine officers.

Our public vessels had very generally been held in port during the time immediately preceding the outbreak of hostilities. The encounter between the *President* and the *Little Belt* December 16, 1811, showed that some vessels, however, were afloat. When war was declared the *Wasp*, then returning from a diplomatic mission to Europe, was the only vessel actually at sea.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A CURIOUS FACT ABOUT SPOTTING.

By CAPTAIN BRADLEY A. FISKE, U. S. Navy.

If an observer be 100 feet above the water, and the sea have waves as high on the average as 10 feet from trough to crest, or 5 feet above the normal surface of the sea, a line drawn from the observer, tangent to any wave, will strike the normal surface of the sea at a distance beyond the wave, depending on the distance of the wave from the observer. If the wave be 6000 yards distant, the line will strike the normal surface of the sea 300 yards beyond the wave. Inasmuch as waves 10 feet high are about 80 yards apart, this line will meet some part of the slope of another wave before it meets the normal surface of the sea. If that wave is 80 yards beyond the first wave, the line will strike it 1⅓ feet lower than its point of tangency with the first wave; that is, 3⅔ feet above the normal surface of the sea.

Therefore, the line of sight from an observer 100 feet high, which just passes above a 10-foot wave, say 6000 yards away, *can never meet the normal surface of the sea, or the water-line of a ship*, unless it be directed along the trough, or nearly so, of a very regular swell.

By "water-line" is meant, of course, the line of flotation of a ship in still water. This is her line of contact with the surface of the globe, and is the line called "water-line of the target" in spotting diagrams.

On the ocean, it can rarely be seen. To a distant observer, every ship seems to lie in a basin, of which numberless waves form the sides, and shut out all view of the "water-line."

Sometimes, the rolling or pitching of a ship raises part of the boot-topping so high that it can be seen above the intervening waves. But the very fact that any part of it can thus be seen, is proof that that part does not then form part of the "water-line."

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ALTITUDE AND AZIMUTH TABLES FOR FACILITATING THE DETERMINATION OF LINES OF POSITION AND GEOGRAPHICAL POSITION AT SEA.

THE SIMPLEST AND READIEST IN SOLUTION.

By LIEUTENANT RADLER DE AQUINO, B. N.,
Naval Attaché to the Brazilian Embassy.

Shortly after the publication of my article "Nomograms for Deducing Altitude and Azimuth, etc.," in last June's issue of these PROCEEDINGS, while in Rio de Janeiro, I succeeded in doing away with certain inconveniences presented by my numerical tables,[1] especially published for the purpose of finding altitudes and azimuths of celestial bodies required in the determination of lines of position and geographical position at sea by Marcq Saint Hilaire's method.

The principal of these inconveniences consisted in the various interpolations and corrections which had to be made before finding the altitude and azimuth. They disappear by taking an *assumed* latitude and longitude instead of the latitude and longitude by D. R. Referring to Fig. 2, we consider now A' (or A'') (the assumed position instead of A, the position by D. R.) for determining the line of position.

[1] A Navegação sem logarithmos. Imprensa Nacional. Rio de Janeiro, 1903. Published by order of the Minister of Marine. This work was preceded by an article by the author in the *Revista Maritima Brazileira*, Oct. 1902: "Taboas para achar alturas e azimuths, etc." Vide also "Resolução Nomographica do Triangulo de Posição" by Dr. G. Pesci. Translated from the Italian into Portuguese by the author and reprinted from the *Revista Maritima Brazileira*, Nov. and Dec. 1907, and Feb. 1908.

In view of the present solution of the problem work was discontinued on the nomograms.

The advantages of using an assumed position instead of the position by D. R. have not been fully appreciated by the majority of navigators. No greater accuracy is gained by determining the line of position from A than from A' (or A''), while the use of either of these positions reduces and facilitates the computations very much, as we will see further on, thus minimizing the chances for error, etc.

In Fig. 1, PMZ is the astronomical triangle of position projected on the plane of the horizon.

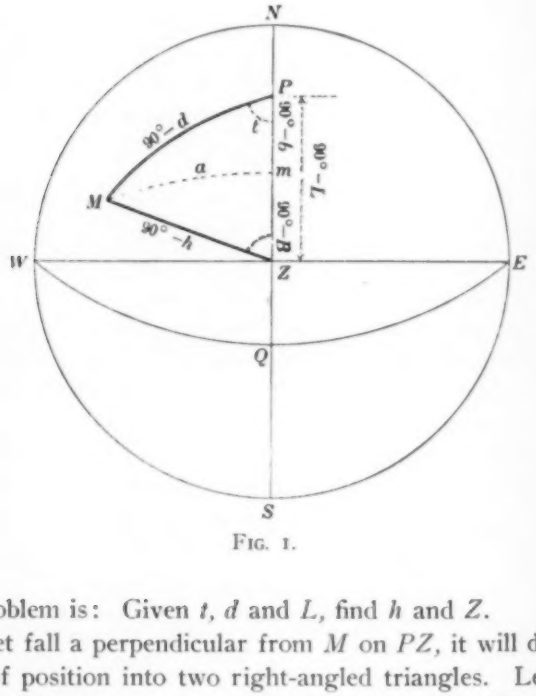


FIG. 1.

The problem is: Given t, d and L, find h and Z.

If we let fall a perpendicular from M on PZ, it will divide the triangle of position into two right-angled triangles. Let us call the perpendicular a and the two parts into which PZ is divided $90° - b$ and $90° - B$.

The perpendicular a is common to the two triangles and therefore to

$$\begin{cases} a \text{ and } b \text{ correspond } d \text{ and } t \text{ in triangle } MPm \\ a \text{ " } B \text{ " } h \text{ " } Z \text{ " " } MZm \end{cases}$$

By Napier's rules we find the following equations binding together these elements:

$$(1)\begin{cases}\sin d = \cos a \sin b \\ \sin h = \cos a \sin B\end{cases} \qquad (2)\begin{cases}\cot t = \cot a \cos b \\ \cot Z = \cot a \cos B\end{cases}$$

and

$$(3)\begin{cases}\sin a = \cos d \sin t \\ \sin a = \cos h \sin Z\end{cases} \qquad (4)\begin{cases}\cot b = \cot d \cos t \\ \cot B = \cot h \cos Z\end{cases}$$

As a, b and B can have values between 0° and 90°, we have tabulated the values of d and t corresponding to various values of a and b (and *ipso facto* the values of h and Z corresponding to a and B).

CALLET's logarithms with seven decimal places were used in the calculations. In some cases eight had to be used.

Two pages (they are only 122 in all) of our new tables are given here in order to show their disposition.[1]

DETERMINATION OF h AND Z.

Let us see now how altitude and azimuth can be easily and rapidly determined by these tables.

Neither a nor b, the arguments of the tables, are known. However, groups (1) and (3) are perfectly similar and show that if we enter the tables with d and t in the place of a and b respectively, we will find in column $\diagdown\!\!\!\begin{matrix}d\\h\end{matrix}$ an approximate value of a. As a is the same in the two triangles this approximate value is sufficient for practical purposes.

In column a we will find approximately the values of d and t given. The value of b is determined for the exact value of d and a value of t is found corresponding to this b.

The values of h and Z will then be found in the same column a corresponding to B.

DETERMINATION OF B.

We will now show how B is determined when L and b are given.

[1] Besides these tables our volume will contain tables for correcting altitudes of the sun, the moon, the planets and the stars; for converting intervals of mean solar time into those of sidereal time, for converting time into arc and vice versa and for rectifying lines of position.

d and L same name $\begin{cases} t<90^\circ \begin{cases} L<b : B=(90^\circ+L)-b\,;\ Z<90^\circ \\ L>b : B=(90^\circ+b)-L\,;\ Z>90^\circ \end{cases} \\ t>90^\circ \ldots\ldots : B=(L+b)-90^\circ\,;\ Z<90^\circ \end{cases}$

d and L different names $\ldots\ldots : B=90^\circ-(L+b)\,;\ Z>90^\circ$

b / B	$a = 12^\circ\ 0'$				$a = 12^\circ\ 30'$				$a = 13^\circ\ 0'$				b / B
	d / h	$\frac{60}{\Delta}$	t / Z	$\frac{\Delta}{60}$	d / h	$\frac{60}{\Delta}$	t / Z	$\frac{\Delta}{60}$	d / h	$\frac{60}{\Delta}$	t / Z	$\frac{\Delta}{60}$	
°	° ′		° ′		° ′		° ′		° ′		° ′		°
0	0 0	1·02	12 0	·0	0 0	1·02	12 30	·0	0 0	1·03	13 0	·0	**0**
1	59	1·03	0	·0	59	1·03	30	·0	58	1·02	0	·0	1
2	1 57	1·02	0	·02	1 57	1·02	30	·02	1 57	1·03	0	·02	2
3	2 56	1·02	1	·02	2 56	1·03	31	·02	2 55	1·02	1	·02	3
4	3 55	1·03	2	·02	3 54	1·02	32	·02	3 54	1·03	2	·02	4
5	4 53	1·02	3	·02	4 53	1·03	33	·02	4 52	1·02	3	·02	**5**
6	5 52	1·02	4	·02	5 51	1·02	34	·02	5 51	1·03	4	·03	6
7	6 51	1·03	5	·03	6 50	1·02	35	·03	6 49	1·02	6	·03	7
8	7 49	1·02	7	·03	7 49	1·03	37	·03	7 48	1·03	7	·03	8
9	8 48	1·02	9	·03	8 47	1·02	39	·03	8 46	1·03	9	·03	9
10	9 47	1·01	11	·03	9 46	1·03	41	·05	9 44	1·02	12	·03	**10**
11	10 45	1·02	13	·05	10 44	1·02	44	·03	10 43	1·03	14	·05	11
12	11 44	1·02	16	·03	11 43	1·03	46	·05	11 41	1·02	17	·05	12
13	12 43	1·01	18	·05	12 41	1·02	49	·05	12 40	1·03	20	·05	13
14	13 41	1·02	21	·07	13 40	1·03	52	·07	13 38	1·03	23	·07	14
15	14 40	1·03	25	·05	14 38	1·02	56	·05	14 36	1·02	27	·05	**15**
16	15 38	1·02	28	·07	15 37	1·03	59	·07	15 35	1·03	30	·07	16
17	16 37	1·02	32	·07	16 35	1·02	13 3	·07	16 33	1·03	34	·08	17
18	17 36	1·03	36	·07	17 34	1·03	7	·08	17 31	1·02	39	·07	18
19	18 34	1·02	40	·08	18 32	1·03	12	·07	18 30	1·03	43	·08	19
20	19 33	1·01	45	·08	19 30	1·02	16	·10	19 28	1·03	48	·08	**20**
21	20 31	1·02	50	·08	20 29	1·03	22	·08	20 26	1·03	53	·10	21
22	21 30	1·03	55	·08	21 27	1·03	27	·08	21 24	1·02	59	·10	22
23	22 28	1·02	13 0	·10	22 25	1·02	32	·10	22 23	1·03	14 5	·10	23
24	23 27	1·03	6	·10	23 24	1·03	38	·12	23 21	1·03	11	·10	24
25	24 25	1·03	12	·10	24 22	1·03	45	·10	24 19	1·03	17	·13	**25**
26	25 23	1·02	18	·12	25 20	1·02	51	·12	25 17	1·03	24	·13	26
27	26 22	1·03	25	·12	26 19	1·03	58	·13	26 15	1·03	32	·13	27
28	27 20	1·03	32	·13	27 17	1·03	14 6	·12	27 13	1·03	39	·13	28
29	28 18	1·02	40	·12	28 15	1·03	13	·15	28 11	1·03	47	·15	29
30	29 17	1·03	47	15	29 13	1·03	22	·13	29 9	1·03	56	·13	**30**
31	30 15	1·03	56	·13	30 11	1·03	30	·15	30 7	1·03	15 4	·17	31
32	31 13	1·03	14 4	·15	31 9	1·03	39	·15	31 5	1·03	14	·15	32
33	32 11	1·02	13	·17	32 7	1·03	48	·17	32 3	1·03	23	·18	33
34	33 10	1·03	23	·17	33 5	1·03	58	·18	33 1	1·03	34	·17	34
35	34 8	1·03	33	·17	34 3	1·03	15 9	·17	59	1·05	44	·20	**35**
36	35 6	1·03	43	·18	35 1	1·03	19	·20	34 56	1·03	56	·18	36
37	36 4	1·03	54	·20	35 59	1·03	31	·20	35 54	1·03	16 7	·22	37
38	37 2	1·01	15 6	·20	36 57	1·05	43	·20	36 52	1·03	20	·22	38
39	38 0	1·05	18	·20	37 55	1·03	55	·22	37 49	1·03	33	·22	39
40	57	1·03	30	·23	38 52	1·05	16 8	·23	38 47	1·05	46	·25	**40**
41	39 55	1·03	44	·23	39 50	1·05	22	·25	39 44	1·05	17 1	·23	41
42	40 53	1·03	58	·23	40 47	1·03	37	·25	40 41	1·03	15	·27	42
43	41 51	1·03	16 12	·27	41 45	1·05	52	·25	41 39	1·03	31	·25	43
44	42 48	1·05	28	·27	42 42	1·05	17 8	·27	42 36	1·05	48	·28	44
45	43 46	1·03	44	·27	43 39	1·05	24	·27	43 33	1·05	18 5		**45**

$\sin d = \cos a \sin b$ $\qquad$ $\cot t = \cot a \cos b$

$\sin h = \cos a \sin B$ $\qquad$ $\cot Z = \cot a \cos B$

d and L same name $\begin{cases} t<90^\circ \begin{cases} L<b: B=(90^\circ+L)-b\,;\, Z<90^\circ \\ L>b: B=(90^\circ+b)-L\,;\, Z>90^\circ \end{cases} \\ t>90^\circ \ldots\ldots: B=(L+b)-90^\circ\,;\, Z<90^\circ \end{cases}$

d and L different names $\ldots\ldots: B=90^\circ-(L+b)\,;\, Z>90^\circ$

b / B	$a = 12^\circ\ 0'$				$a = 12^\circ\ 30'$				$a = 13^\circ\ 0'$				b / B
	d / h	60 / Δ	t / Z	Δ / 60	d / h	60 / Δ	t / Z	Δ / 60	d / h	60 / Δ	t / Z	Δ / 60	
°	° ′		° ′		° ′		° ′		° ′		° ′		°
45	43 46	1·05	16 44	·28	43 39	1·04	17 24	·30	43 33	1·05	18 5	·30	45
46	44 43	1·05	17 1	·30	44 37	1·05	42	·30	44 30	1·05	23	·32	46
47	45 40	1·03	19	·30	45 34	1·05	18 0	·33	45 27	1·05	42	·33	47
48	46 38	1·05	37	·33	46 31	1·05	20	·33	46 24	1·07	19 2	·35	48
49	47 35	1·05	57	·35	47 28	1·07	40	·37	47 20	1·05	23	·37	49
50	48 32	1·05	18 18	·37	48 24	1·05	19 2	·37	48 17	1·07	45	·40	50
51	49 29	1·07	40	·38	49 21	1·05	24	·40	49 13	1·07	20 9	·40	51
52	50 25	1·05	19 3	·40	50 18	1·07	48	·42	50 9	1·05	33	·43	52
53	51 22	1·05	27	·43	51 14	1·07	20 13	·45	51 6	1·07	59	·47	53
54	52 19	1·07	53	·45	52 10	1·07	40	·47	52 2	1·09	21 27	·48	54
55	53 15	1·07	20 20	·48	53 6	1·07	21 8	·50	57	1·07	56	·50	55
56	54 11	1·07	49	·50	54 2	1·07	38	·52	53 53	1·09	22 26	·53	56
57	55 7	1·07	21 19	·53	58	1·09	22 9	·55	54 48	1·09	58	·57	57
58	56 3	1·07	51	·58	55 53	1·07	42	·58	55 43	1·09	23 32	·62	58
59	59	1·09	22 26	·60	56 49	1·09	23 17	·63	56 38	1·09	24 9	·63	59
60	57 54	1·09	23 2	·63	57 44	1·11	55	·65	57 33	1·11	47	·68	60
61	58 49	1·09	40	·70	58 38	1·09	24 34	·72	58 27	1·11	25 28	·72	61
62	59 44	1·11	24 22	·72	59 33	1·11	25 17	·75	59 21	1·11	26 11	·77	62
63	60 38	1·11	25 5	·78	60 27	1·13	26 2	·80	60 15	1·13	57	·82	63
64	61 32	1·11	52	·83	61 20	1·11	50	·85	61 8	1·13	27 46	·88	64
65	62 26	1·11	26 42	·88	62 14	1·13	27 41	·92	62 1	1·15	28 39	·91	65
66	63 20	1·13	27 35	·97	63 7	1·15	28 36	·97	53	1·15	29 35	1·0	66
67	64 13	1·15	28 33	1·02	59	1·15	29 34	1·05	63 45	1·15	30 35	1·07	67
68	65 5	1·15	29 34	1·10	64 51	1·18	30 37	1·13	64 37	1·20	31 39	1·13	68
69	57	1·18	30 40	1·20	65 42	1·18	31 45	1·20	65 27	1·22	32 47	1·23	69
70	66 48	1·18	31 52	1·27	66 33	1·20	32 57	1·30	66 18	1·22	34 1	1·32	70
71	67 39	1·20	33 8	1·38	67 23	1·22	34 15	1·40	67 7	1·25	35 20	1·41	71
72	68 29	1·22	34 31	1·50	68 12	1·22	35 39	1·52	55	1·25	36 46	1·51	72
73	69 18	1·25	36 1	1·62	69 1	1·28	37 10	1·65	68 43	1·28	38 18	1·65	73
74	70 6	1·28	37 38		48	1·30	38 49		69 30	1·33	39 57		74
75	53	1·33	39 24		70 34	1·33	40 35		70 15	1·36	41 44		75
76	71 38	1·33	41 18		71 19	1·40	42 30		59	1·40	43 40		76
77	72 23	1·40	43 23		72 2	1·43	44 35		71 42	1·46	45 45		77
78	73 6	1·46	45 38		44	1·50	46 50		72 23	1·54	48 0		78
79	47	1·54	48 5		73 24	1·54	49 17		73 2	1·62	50 26		79
80	74 26	1·67	50 45		74 3	1·72	51 56		39	1·72	53 3		80
81	75 2	1·72	53 39		38	1·76	54 48		74 14	1·88	55 53		81
82	37	1·94	56 47		75 12	2·0	57 53		46	2·0	58 55		82
83	76 8	2·14	60 10		42	2·22	61 12		75 16	2·11	62 10		83
84	36	2·40	63 49		76 9	2·5	64 45		42	2·61	65 38		84
85	77 1	2·86	67 42		33	3·0	68 32		76 5	3·0	69 19		85
86	22	3·76	71 50		53		72 32		25		73 11		86
87	38	5·0	76 10		77 9	3·75	76 43		40	4·0	77 14		87
88	50	7·5	80 41		21	5·0	81 3		51	5·56	81 24		88
89	58	30	85 18		28	8·57	85 30		58	8·57	85 41		89
90	78 0		90 0		30	30	90 0		77 0	30	90 0		90

$\sin a = \cos d \sin t$ $\qquad$ $\cot b = \cot d \cos t$

$\sin a = \cos h \sin Z$ $\qquad$ $\cot B = \cot h \cos Z$

When the perpendicular a falls between P and Z, as it does in Fig. 1 (L and d being of the same name and $t < 90°$), we have

$$90° - B + 90° - b = 90° - L$$

and therefore

$$B = 90° + L - b \quad : \quad \text{when } L < b.$$

If the perpendicular fell between Q and Z (L and d being of the same name and $t < 90°$) we would have

$$90° - B + 90° - L = 90° - b$$

and therefore

$$B = 90° + b - L \quad : \quad \text{when } L > b.$$

In case the perpendicular fell between P and N (which only happens when $t > 90°$) we have

$$90° - B = 90° - b + 90° - L$$

and therefore

$$B = (L + b) - 90°$$

Finally, when the perpendicular falls between Q and S (L and d are then of different names) we have

$$B = 90° - (L + b)$$

Thus, when

d and L same name $\begin{cases} t<90° \begin{cases} L<b : B=(90°+L)-b ; Z<90° \\ L>b : B=(90°+b)-L ; Z>90° \end{cases} \\ t>90° \ldots : B=(L+b)-90° ; Z<90° \end{cases}$

d and L different names $\ldots : B=90°-(L+b) ; Z>90°$

By these formulæ B can be obtained from b and L without giving consideration to algebraic signs. The parentheses show that the quantities in them ought to be added first in order to simplify calculations.

The determination of B is thus very simple.

In the first two cases, 90° is always added to the smaller of the two quantities b and L; and from this sum is subtracted the larger of the two.

In the third and fourth cases b and L are always added together. If their sum is greater than 90°, 90° is subtracted from it. If the sum is smaller than 90°, it is subtracted from 90°.

These precepts are placed at the top of each page of the tables as a convenient aid to the memory and they present the advantage of doing away with the necessity of considering algebraic signs or giving names to b and B.

The quadrant in which the observed body is, is also shown for reference, when not known *a priori*. When $Z < 90°$ the azimuth given by the tables is reckoned from the elevated pole to East or West and when $Z > 90°$ from the depressed pole to East or West, since the tables only give values up to 90°.

TYPICAL EXAMPLE FOR ALL SIGHTS.

The following typical example is given in order to illustrate the way in which all sights ought to be treated:

Case of the Sun.

On August 21, 1908, about 11^h a. m., in Lat. by D. R. 16° 16′ S.[2] and Long. by D. R. 38° 18′ W., the observed altitude of the sun's lower limb, bearing northward and eastward, was 59° 0′ at $1^h\ 19^m\ 40^s$ of the chronometer, $26^m\ 57^s$ slow of G. M. T. Height of eye 28 ft. Required the line of position and the ship's most probable position.

C = $1^h\ 19^m\ 40^s$
C. C. = + 26 57
G. M. T. = $1^h\ 47^m\ 37^s$
Eq. of T. = − 3 3
G. A. T. = $1^h\ 43^m\ 34^s$ or ⊙'s Geog. Long. = 25° 54′ W
Long. by D. R. = 38 18 W
⊙'s $t_{D.R.}$ = 12° 24′ E
⊙'s $t_{AS.}$ = 12 17
Ass. Long. = 38° 11′ W

b = 12° 26′.2
$L_{AS.}$ = 16 33 .8 S
$L_{AS.} + b$ = 29° 0′

⊙'s d = 12° 9′.7 N
a = 12°
h_S = 59° 0′
Corr. = + 10′
h = 59° 10′
$h_{AS.}$ = 58 49
$h - h_{AS.}$ = + 21′

25.7
1.02
514
2570
26.2
.05
1.31

B = 61°

$Z_{AS.}$ = 23° 40′ NE

[2] As in practice an assumed latitude is used instead of the latitude by D. R., it is better, in order to avoid mistakes, not to consider the latitude by D. R. at all, only the longitude by D. R., except when only one observation is available and the ship's most probable position has to be taken. The longitude by D. R. itself is only used to find a.

Working out this example with 7 decimal place logarithms we would find

$$b = 12^\circ\ 26'\ 16'',\ h = 58^\circ\ 48'\ 53'' \text{ and } Z = 23^\circ\ 40'\ 50''$$

by means of groups of equations: (2) for Z and (4) or (1) for h. Group (3) constitutes the check group, because it contains d and t given and h and Z required.

log sin d = 9.32360 43	log tan d = 9.33346 22
log sin B = 9.94181 93	log sec t = 0.01005 77
log cosec b = 0.66679 62	log tan b = 9.34351 99
log sin h = 9.93221 98	$b = 12^\circ\ 26'\ 16''$
$h = 58^\circ\ 48'\ 53''$	$L = 16\ \ 33\ \ 44$
	$L + b = 29^\circ\ \ 0'\ \ 0''$
log tan t = 9.33791 94	$B = 61\ \ 0\ \ 0$
log cos b = 9.98968 58	
log sec B = 0.31442 88	log cot B = 9.74375 20
log tan Z = 9.64203 40	log sec Z = 0.03819 99
$Z = 23^\circ\ 40'\ 50''$	log cot h = 9.78195 19
	$h = 58^\circ\ 48'\ 53''$
log cos d = 9.99014 21	log cos h = 9.71416 81
log sin t = 9.32786 17	log sin Z = 9.60383 37
log sin a = 9.31800 38	log sin a = 9.31800 18
$a = 12^\circ\ 0'\ 13''$	$a = 12^\circ\ 0'\ 13''$

This development shows the time and trouble our tables save, besides lessening the chances of error and simultaneously checking, *per se*, the results. Of course, in actual practice, only five decimal places would be used, and this is why we have separated the last two.

EXPLANATION.

After the correction is applied to the chronometer time and the equation of time to the G. M. T. we find G. A. T. also called the "sun's geographical longitude" (⊙'s G. L.), because it is the sun's hour angle from Greenwich. This G. A. T. is *immediately* converted into arc[4] and combined with the Long. by D. R. giving the sun's hour angle from D. R. or $t_{D.R.}$ in arc.

[4] This procedure, not usually followed in the text books, has the triple advantage of simplifying the determination of t, abolishing the argument in time in the tables and the necessity of dealing with data expressed in time and in arc after G. A. T. is converted.

The declination of the sun is found in the Nautical Almanac at the same time as the Eq. of T. and taken with an approximation of one-tenth of one minute. (It will be noticed that no seconds of arc are used in our method nor are they necessary, and only the declination need be taken within one-tenth of one minute.)

Entering the tables with $d = 12°$ in column a and with $t_{D.R.} = 12° 24'$ in column b, we find in column $\frac{d}{h}$: $12°$ which is the approximate value of a.

Therefore in column $a = 12°$ (in this particular case by coincidence the same) we find that the sun's declination $12° 9'.7$ is comprised between $11° 44'$ and $12° 43'$ respectively corresponding to $b = 12°$ and $b = 13°$. Interpolating (here the interpolation is reduced to the multiplication of the difference between $12° 9'.7$ and $11° 44'$, that is $25'.7$ by the factor 1.02) we find that $b = 12° 26'.2$ and $t_{AS.}$ corresponding to this value of b is $12° 17'$.

In order to do away with any corrections, this $t_{AS.}$ which differs from $t_{D.R.}$ *seven minutes* is taken as the hour angle. Combining it with the ⊙'s Geog. Long. we find a longitude which may be called *assumed*.

In order to do away with any further interpolations, B is made a whole number of degrees by *assuming* a latitude, nearly the same as the Lat. by D. R., that will make it so. In our particular case it will be seen that $L_{AS.} = 16° 33'.8$ combined with $b = 12° 26'.2$, according to the precepts given, will make B just $61°$.

Therefore in the same column $a = 12°$ with $B = 61°$, we will find $h_{AS.} = 58° 49'$ and $Z_{AS.} = 23° 40'$.

Fig. 2, representing a section of a chart of the coast of Brazil, shows A the position by D. R. and A' the *assumed* position from which the line of position is determined. The *altitude difference* is $A'B' = +21'$. $B'B''$ is the line of position perpendicular to $A'B'$. B the foot of the perpendicular dropped from the position by D. R. on the line of position is the ship's most probable position and *must* be taken as the ship's position when only one observation is available.

This line of position is just as valuable as the isolated knowledge of latitude or longitude, and represents the exact and only true interpretation of the sight.

Cases of the Moon, Stars and Planets.

Observations of the moon, stars and planets are worked out the same was as those of the sun, excepting the way in which the $t_{R.D.}$

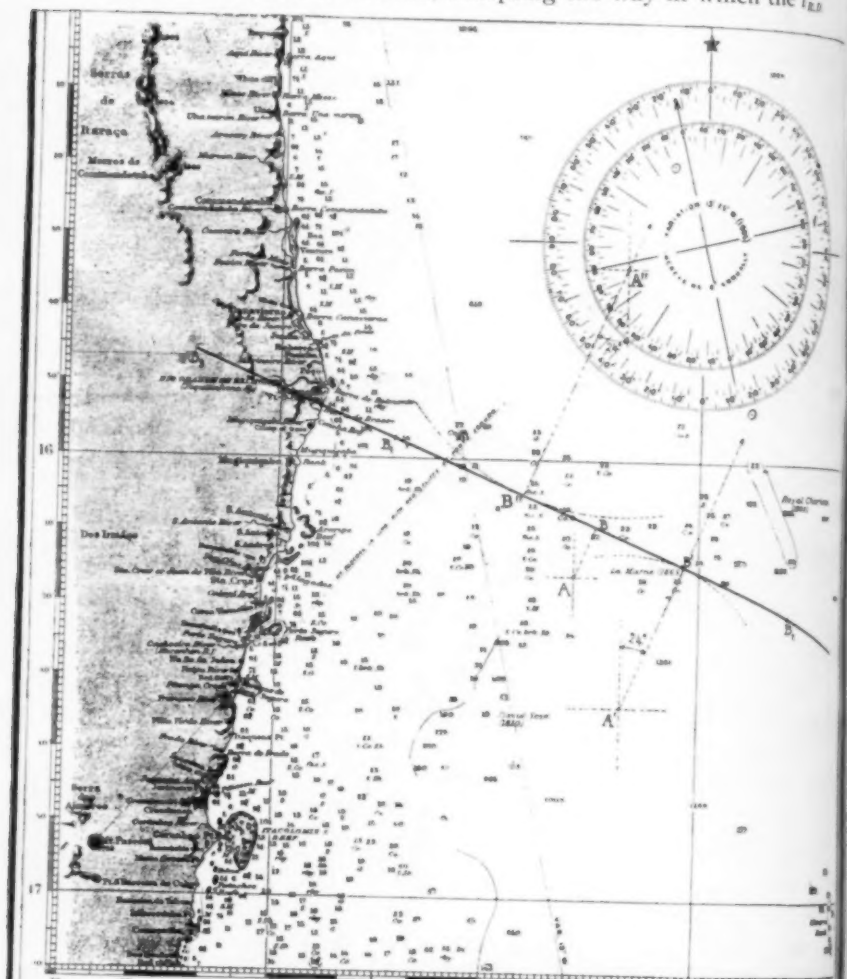


FIG. 2.—Section of chart showing how line of position is plotted and ship's most probable position found.

is determined. After correcting the chronometer and finding G. M. T. this interval of mean time is converted into an interval

of sidereal time to which is added the sidereal time at Greenwich mean noon (or the R. A. of the mean sun at the same instant) in order to find G. S. T.[5] This G. S. T. combined with the observed body's R. A. will give us the body's geographical longitude or its hour angle from Greenwich. This geographical longitude is converted *immediately* into arc and combined with the Long. by D. R., finally giving the body's $t_{D.R.}$

LINES OF POSITION DETERMINED WITHOUT AZIMUTHS.

If we assumed the latitude as 15° 33'.8 instead of 16° 33'.8, B would be 62° and $h_{AS.} = 59°\ 44'$ and $Z_{AS.} = 24°\ 22'$. As the assumed longitude is the same, 38° 11' W., the assumed position would be A'' (see Fig. 2) and the altitude difference —34'.

With the two assumed positions A' and A'' (60' apart on the same meridian) and the two altitude differences +21' and —34' the line of position can be found by drawing a line tangent to the two dotted circles drawn from A' and A'' respectively with 21' and 34' as radii.

This process appearing now for the first time gives a line of position independent of the observed body's azimuth and its use facilitates the plotting of the line of position. It will prove very useful for plotting, with greater accuracy, lines of position on Mercator's chart when the latitude is higher than 45°,[6] especially when the body is near the prime vertical and the altitude difference is large.

A comparison of the two azimuths will control the coincidence of the straight line of position $B'B''$ and the curve of position (not

[5] The use of a sidereal chronometer on board ship would simplify matters and render more attractive observations of the moon, stars and planets. However, a mean time chronometer may be taken as a sidereal chronometer as long as its daily rate is taken as $3^m\ 55^s.9 \pm$ daily rate. If the Nautical Almanac gave the sun's, the moon's and the planets' declinations and right ascensions for 0^h G. S. T., only one process for finding G. L. would need to be followed in all cases.

[6] To those (especially those who navigate in latitudes higher than 45°) who take interest in this subject we heartily recommend a study recently published as a "supplement" to the *Rivista Marittima* for July-August, 1908, entitled "Sulla Teoria e la Pratica della Nuova Navigazione Astronomica," by Dott. A. Alessio, Tenente di Vascello, Royal Italian Navy.

represented on the chart), as it is evident the greater the difference between the two azimuths less will the two lines coincide.

However, this comparison need only be made when $t < 45°$ and the observed body's declination is smaller than its altitude ($d < h$).[1] When $d < h$ and $t > 45°$ or $d > h$ the curve of position and the straight line of position on Mercator's chart coincide within 1′ for a distance equal to or greater than 82′.9 on each side of the ship's most probable position.

In our typical example the line of position $B'B''$ coincides with the corresponding curve of position within 1′ for a distance of 59′.5 on each side of the ship's most probable position B. B_1 and B_2, 30′ from B, are only .2 of a mile distant from the curve of position. B_3 and B_4 (not shown on the chart), 59′.5 from B, are just 1 mile distant.

IDENTIFICATION OF CELESTIAL BODIES.

The problem of identifying celestial bodies is the reverse of the problem of determining altitude and azimuth, and, therefore, we ought to begin by finding with h and Z the column a in which we have to work proceeding backwards until d and t are found. As no great approximation is required in this case the tables offer exceptional advantages for solving this problem too.

COURSE AND DISTANCE IN GREAT CIRCLE SAILING.

The problem of finding course and distance in Great Circle sailing may also be solved by our tables, because it is the same as determining altitude and azimuth. The zenith distance or complement of the altitude corresponds to the distance and the azimuth to the course. The only difference is that the distance between the two given points can be greater than 90°, whereas the zenith distance cannot be greater than 90°.

OTHER PROBLEMS SOLVED.

All the other problems in Nautical Astronomy depending on the solution of right-angled spherical triangles can be easily solved by these tables. Some of these problems are: Time-azimuths, time-

[1] For details vide the author's: "Limites de coincidencia da recta Marcq Saint Hilaire com a curva de posição correspondente." (Reprinted from the *Revista Maritima Brazileira*, July, 1906, page 41.)

altitude-azimuths, horizon-azimuths or amplitudes, hour angle of a celestial body in the horizon (time of sunset and sunrise, etc.), altitude and hour angle of a celestial body on the prime vertical, altitude and hour angle of a celestial body when position angle is 90°, etc.

	PROBLEM	FORMULA	FORMULA
	Fundamental equations	$\sin d = \cos a \sin b$	$\cot t = \cot a \cos b$
I	Time azimuths for deviation.	Use same method as for h and Z.	
II	Horizon azimuths: given d and t	$\sin Z = \cos d \sin t$	$\cot (90° - d) = -\cot L \cos t$
	" " d " L	$\sin d = \cos Z \sin (90° - L)$	When d and L are of the same names, take $180° - b$ for value of t.
III	When variation in altitude is the greatest: Body on prime vertical. $L > d$	$\sin d = \cos (90° - L) \sin h$	$\cot L = \cot d \cos t$
	When variation in altitude is the greatest: Body's position angle is 90°. $L < d$	$\sin L = \cos (90° - d) \sin h$	$\cot d = \cot L \cos t$
IV	Time-altitude-azimuth. Given d, t and h.	Find a with d and t. In column a corresponding to h will be found Z.	

CONCLUSION.

The writer during his recent trip from Rio de Janeiro to New York on the S.S. *Voltaire*, Lamport and Holt Line, worked out many sights taken under various circumstances by his modified tables and the improved method as explained here, with the most satisfactory results.

Only two openings of the tables are necessary. The first is immediately indicated by the value of d and the second by the value of a. No time is lost in turning pages, especially if they are indexed.

The fact that the perpendicular a is common to the two right-angled triangles reduces the bulk of the tables to a *minimum*.

The use of an *assumed* position instead of the position by D. R. greatly simplifies the calculations involved in the determination of h and Z.

In the typical example presented no actual figures used have been suppressed. The tables give h with an approximation of *one-half of one minute* and in the majority of cases with greater approximation. Z is always found with sufficient approximation for practical use. No errors accumulate in this method and this is why the data does not need to be taken with seconds of arc.

Marcq Saint Hilaire's method gives the same results as other methods when circumstances are favorable for their use. When circumstances are unfavorable for other methods Marcq Saint Hilaire's method gives very satisfactory results, which are then the best obtainable. When lines of position are determined Marcq Saint Hilaire's method always gives the best results.

For these reasons we always treat *all* sights by his method.

The writer expects to publish the tables soon with all improvements indicated. He hopes the reader has appreciated the great advantages these tables present. Indeed, we may safely say: *They are "the simplest and readiest in solution."*

WASHINGTON, October 4, 1908.

DISCUSSION.

The Summary Court-Martial—Past, Present and Future.

COMMANDER C. A. GOVE, U. S. NAVY.—I am in complete accord with the writer relative to the abolishment of so much red tape and to simplify the work as much as possible consistent with the law, but do not agree with him in any scheme whereby the power of the commanding officer is reduced or the power of punishment given to any other than the commanding officer.

To insure justice and uniformity of all punishments on the ships, acting singly, in squadrons and fleets, I would recommend that the law be changed to act as follows:

(a) A list of offenses carrying with it a punishment which shall be tried by a General Court-Martial.

(b) A list of offenses carrying with it a punishment which shall be tried by a Summary Court-Martial.

(c) A classified list of offenses (not mentioned in the list for a General Court-Martial or Summary Court-Martial) the punishment for which shall consist of loss of pay, not to exceed a stated sum for each class of offenses. This to be assigned by the commanding officer.

That the Commander-in-Chief be authorized to approve all parts of the sentence of a General Court-Martial and the senior officer present all parts of a Summary Court-Martial.

The True Story of the America.

(SEE NO. 126.)

ROBERT W. NEESER.—During a recent trip abroad I was fortunate enough to secure further material on the subject of the fate of the *America*.

This consists of the following copy of the original MS. report made by the commission appointed to examine the condition of the vessel, dated August 12, 1786. A translation is appended.

BREST, 1786. CONSEIL DE LA MARINE SÉANCE DU 12 AOÛT. NO. 95.

RAPPORT AU CONSEIL DE MARINE DE LA COMMISSION ORDONNÉE POUR LA VISITE DU VAISSEAU "L'AMERICA."

Nous Commissaires només par le Conseil pour faire la visite du Vaisseau *L'America*, nous sommes transportés dans le bassin de Brest où l'on a fait échouer ce vaisseau afin de pouvoir procurer le moien de le visiter avec plus de soin et sans danger pour le vaisseau et avons procédé en présence de Monsieur le Marquis de la porte Vezin Chef d'Escadre Comandant la Marine en ce port à l'examen le plus scrupuleux cy après énoncé.

Nous avons trouvé que préalablement on avait fait délivrer dans toute l'étendue de la calle depuis le mât de mizaine jusqu'aux cloisons des soutes

à poudre quantité de vaigrages et plusieurs piéces de serres d'empatures dont la surface semblait n'offrir aucun vice, mais qui sondées à deux pouces de profondeur étaient entiérement pourries. Toute la membrure découverte sous ces vaigres s'est trouvée dans le plus mauvais état et entiérement consomée au nombre de 65 piéces côté de tribord tant varangues que genoux et premiéres allonges, et 46 côté de babord et cela sans interruption.

Nous avons ensuite procédé à la visite des serres du faux pont que nous avons trouvés également pourries. Nous avons fait sonder tous les baux du premier et second pont et gaillards avec la tariére il a été reconnu en tout 86 demis baux ne rendant absolument que de la poussiére.

Toutes les goutieres et serres goutieres des poutres ayant été visitées par les calfats, ont été reconnues entiérement pourries et toujours sous la même apparence de bonté sur la superficie, que les vaigres de la calle.

Nous avons ensuite examiné le dehors et avons trouvé que l'on avait précédemment délivré vingt-quatre bouts de bordages ou rombaillets tribord et babord à différentes hauteurs, toute la membrure découverte au nombre de 160 piéces a été reconnue entiérement consommée et réduite en poussiére. Toutes les gournables dans toute l'étendue de la caréne sont totalement pourries, tout le franc bord par suitte de la pourriture des gournables et par l'essence trés mauvaise des bois qui le composent a été reconnu également entiérement pourri.

Nous avons fait sonder l'étrave et l'étambot à différentes hauteurs et nous les avons trouvés gatés dans tous les endroits découverts. On avait délivré plusieurs pieces de tour de l'arcasse qui laissant à découvert les estains et toutes les barres les ont fait reconnaitre en si mauvais état que toutes tombaient en poussiéres.

D'après cet examen trés détaillé et la présomption fondée que nous devons avoir, nous considérons que ce vaisseau est réduit en totalité à un tel état de destruction qu'il n'est pas susceptible d'être refondu, que nous n'oserions même proposer de l'employer dans le port pour le service de ponton par la crainte que sous peu de temps il ne vint à manquer totalement au premier justant. Nous sommes d'autant moins portés à croire que l'on doive procéder à sa refonte que construit sur une forme qui ne nous parait pas for avantageuse ny annoncer des qualites, il n'a point d'ailleurs le creux qu'il convient de donner aux vaisseaux de son rang d'où il résulterait qu'il ne pourrait être armé avec plus de deux mois et demi ou au plus trois mois de vivres.

Ce vaisseau ayant été donné au Roy par les américains nous avons l'honneur de proposer au Conseil de demander au Ministre d'en perpétuer le nom par la reconstruction d'un nouveau vaisseau plus avantageux par ses qualités et par ses dimensions, et d'en ordonner la démolition le plutôt possible.

Les courbes d'assez belles dimensions qui ont été emploiées dans sa construction pourront être de ressource pour le service.

A Brest le 11 août 1786./.

Signé: Collart de Suville, faisant fonctions de Directeur Général.

(The original copy of this report is in the files of the Navy Yard at Brest.)

BREST, 1786. MARINE BOARD MEETING OF AUGUST 12.

REPORT TO THE MARINE BOARD OF THE COMMITTEE APPOINTED TO EXAMINE SHIP "AMERICA."

We, members of the committee appointed by the Board to make an inspection of the ship *America*, repaired to the dock of Brest where this vessel has been beached in order to afford the means of examining her with great care and without danger to the vessel, and we proceeded, in the presence of M. le Marquis de la porte Vezin, rear-admiral, commanding the maritime district of this port, to the most searching inspection here below stated.

We found that there had been previously removed from the entire length of the hold, from the foremast to the bulkhead of the magazines, a large number of planking and several planks (more literally "thick-stuff joints") the surface of which seemed to indicate no imperfection, but which, when sounded at two inches beneath the surface, were entirely rotten. The whole frame uncovered beneath these plankings was found to be in the worst condition and entirely worn away.

We then began the examination of the stringers of the lower deck, which we found equally rotten. We caused all the beams of the first and second decks and of the forecastle to be sounded with an auger. Eighty-six half-beams were found to contain absolutely nothing but dust.

All the gutters and inner-waterways of the beams having been examined by the calkers, were found to be entirely rotten and always under the same appearance of good condition on the surface, as the planks of the hold.

We then examined the outside and found that there had been removed previously 24 pieces of planking or graving-pieces on the starboard and port sides at different heights; all the timbers uncovered, numbering 160 pieces, were found entirely worn away, and reduced to dust. All the tree-nails, the whole length of the keel, are entirely rotten; the entire free-board, as a result of the rotting of the treenails and the very poor quality of the timber of which it is constructed, were likewise found entirely rotten.

We caused the stem and the stern-post to be sounded at different heights, and found them damaged in all places exposed. Several "pieces de tour" of the arcasse had been removed, thereby uncovering the fashion-timbers and all the bars, showing them to be in such bad condition that they all crumbled into dust.

As a result of this very minute examination, and our just ground of belief, we consider that this vessel is wholly reduced to such a state of destruction that it is not possible to repair her, that we would not dare to propose her being used in port, even as a hulk, for fear that in a short while she would go all to pieces with the first ebb-tide. We are all the less inclined to believe that her refitting should be proceeded with because her model offers no advantages, nor does it show any qualities, besides lacking the suitable depth for vessels of her class; the consequence being that she could not carry supplies for more than two months and a half, or three months at the most.

This vessel having been presented to the King by the Americans, we have the honor of proposing to the Board to request the minister to perpetuate her name by the building of a new ship which, by her qualities and dimensions, would offer greater advantages, and to order that she (this vessel) be broken up as soon as possible.

The knees which have been used in her construction are of quite fair dimensions, and may be of help to the service.

At Brest, the 11th of August, 1786./.

Signed: Collart de Suville, acting as Bureau Chief.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Radetzky	14,500	Trieste.	Building.
Zrinyi	14,500	"	"
Erzherzog Franz-Ferdinand	14,500	"	Launched Sept. 30, 1908.
Scout.			
Admiral Spaun	3,500	Pola	Building.

On September 30 the *Ersatz Kr. Stephanie*, the first of the three 14,500-ton battle-ships building at the Stabilimento Tecnico of Trieste, was successfully launched and named *Erzherzog Franz-Ferdinand*. This ship was laid down in February, 1906. Her battery will consist of four 12-inch 45-caliber guns in two axial turrets, eight 9.56-inch in four broadside turrets and twenty 3.94-inch; also three 18-inch submarine torpedo-tubes. She is to have triple expansion engines, to give a speed of 20.5 knots.

The first of two submersibles of Germania type building for Austria was recently launched at Kiel. She is of 600 tons displacement, 13 knots surface and 9 submerged speed.

The new regulations as to the marriage of Austrian naval officers are, on the whole, similar to those applicable to the land forces. One-third only of the executive officers may be married, whereas engineer officers and naval surgeons may marry to the extent of 66 per cent. Officers applying for leave to marry must prove a special investment at 4 per cent of a capital sum, varying, according to rank, from 15,000 to 60,000 kronen (£625 to £2500). In the case of officers under 30 years of age the investment must be 50 per cent higher in value.—*Army and Navy Gazette.*

BRAZIL.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Minas Geraes	19,250	Elswick.	Launched Sept. 10, 1908.
Rio de Janeiro	19,250	"	Ordered.
San Paulo	19,250	Vickers.	Building.
Scouts.			
Bahia	3,500	Elswick.	Building.
Rio Grande	3,500	"	"

The Brazilian battle-ship *Minas Geraes* was launched at Elswick on September 10. The machinery is in a forward state in Messrs. Vickers, Son & Maxim's shops at Barrow, while the 12-inch guns and mountings for her and her sister ship are well advanced at Elswick. Nearly all the belt armor is in place. The arrangement of the after magazines in this vessel and the *San Paulo*, being built at Barrow, is distinctly novel. The engines, which are of the reciprocating type, are set wider apart than usual, and shell-handling rooms are situated in a 16-foot passage arranged between the two engine-rooms. The magazines for the midship turrets are arranged between the engine-room and after stokehold.—*The Engineer.*

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Danton	18,350	Brest.	Building.
Mirabeau	18,350	Lorient.	"
Voltaire	18,350	Bordeaux.	"
Diderot	18,350	St. Nazaire.	"
Condorcet	18,350	"	"
Vergniaud	18,350	La Seyne.	"
Armored Cruisers.			
Edgard Quinet	13,644	Brest.	Launched Sept. 21, 1907.
Waldeck-Rousseau	13,644	Lorient.	" Mar. 4, 1908.

THE NAVAL PROGRAM.—The proposals for the French naval budget for 1909 have been published. It appears that the dockyards and private yards will have at least eighty-two vessels in hand, including twenty-eight destroyers and forty-five submarines. The following vessels are expected to be completed during the year: The armored cruiser *Edgard Quinet;* ten destroyers, being the *Glaive, Poignard* and *Massue*, which are building in the dockyards, and the *Mameluck, Voltigeur, Fantassin, Tirailleur, Lansquenet, Chasseur* and *Cavalier*, which are in hand in private yards; twelve submarines, being two of the *Emeraude* type, two of the *Pluviose* type, Nos. Q73, 74, 75, 76, 82, 83, 84 and 89. A gunboat will also be completed, the *Doudart de Lagree*, intended for the Yang-tse. Only thirteen vessels will be put in hand, all of them small units—seven destroyers and six submersibles. When the budget was under discussion M. Thomson, Minister of Marine, proposed to put in hand other battle-ships of 20,000 tons, constituting a new homogeneous squadron of six vessels, but the Ministerial Council did not sanction the proposal.—*Nautical Gazette.*

According to the *Rivista Marittima*, a recent speed trial of some of the French Mediterranean fleet ships resulted as follows:

	Knots.
Patrie	18
Démocratie	17.75
Republique	17.25
Suffren	14
Bouvet	12

The course was Ajaccio to Toulon, a distance of 160 miles odd.

Target practice results for the same squadron at an average range of 5000 yards were:

	Per cent.
Jules Ferry	33.1
Victor Hugo	28.4
Bouvet	26.0
Jaureguiberry	22.5
Suffren	21.5
Patrie	21.4
St. Louis	17.8
Démocratie	16.8
Justice	16.0
Charlemagne	15.7
Gaulois	14.0
Liberté	13.8
Republique	11.7

making an average of 20 per cent for the fleet.

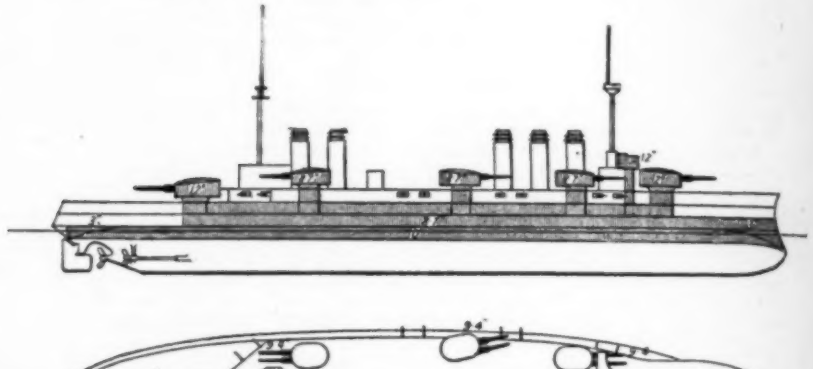
In torpedo the *Republique* came first, with 3 in 6 minutes; the *Patrie* and *Démocratie* next, with 3 in 7 minutes. These results are hardly what may be described as "excellent."—*The Engineer.*

The French submarine *Emeraude* succeeded brilliantly in her run of 700 miles without mishap at a speed of 9 knots, from Cherbourg to Brest, Brest to Dunkirk, and Dunkirk to Cherbourg. The *Emeraude* belongs to a class of six submarines, and is propelled on the surface by a heavy petroleum motor of the Diesel type, and submerged by electric motors. She carries two officers and nineteen men. The trial was thought conclusive, and the motor worked without mishap for eighty hours. The cruise was made on the surface, and of course not submerged, as some of the papers said. The boat was provided with what is described as an aerial compass, which was thought indispensable, or at least useful for such a run, but the regulation of the compass presented some difficulties. Three submersibles, the *Ventôse*, *Pluviôse* and *Germinal*, have since made the same cruise, we believe with perfect success. These are vessels propelled by steam, the boilers working with petroleum. The new submersible *Prairial*, which belongs to the same series, has been submerged to test her construction, and no leakage was discovered. She has since been commissioned for trial.

The port of Lorient has been informed that the five new destroyers of 750 tons recently ordered from various companies, and to be provided with turbines and boilers with oil fuel, are to undergo their trials at that port. These are the *Boutefeu*, which is being built by Messrs. Dyle & Bacalan at Bordeaux; the *Cimeterre* and *Dague*, now building at the Chantier de Gironde; and the *Fourche* and *Faulx* at the yard of Messrs. La Brosse & Fouché at Nantes. These boats are to be built within twenty-six to thirty-one months. Hitherto the boats built on the Gironde have been tried at Rochefort, but henceforth apparently Lorient is to take up the duties. The *Fourche* and *Faulx* are to have turbines on the Rateau system, with 600 revolutions per minute, giving a speed of thirty-one knots. The Du Temple boilers will be stoked with petroleum. The La Brosse yard will also undertake the building of a tug and a gunboat for the Yang-tse.—*Army and Navy Gazette*.

MODERN FRENCH BATTLE-SHIPS.—By far the most important section of the French Navy is the group of six battle-ships of the *Danton* class (1906-7) due to be completed in 1910-11-12. They are of a modified *Dreadnought* type, carrying four 12-inch 50-caliber guns, and twelve 9.4-inch guns also of 50 calibers lengths. It is a question whether the gain in the rapidity of fire, due to the use of the lighter 9.4s, is compensated by the loss of energy of the individual projectiles. The English evidently think not; for they built but two ships of the *Danton* type, namely, the *Nelson* and *Agamemnon*, and in their late ships, in common with the other naval powers, are using the 12-inch exclusively as the main armament. In the *Danton*, the 12-inch guns are carried in turrets protected by 12 inches of armor, and the 9.4s are mounted in pairs in turrets protected by 8.7 inches of armor. They carry a belt 10 inches in thickness amidships and 6 inches at the ends, and this excellent side protection extends to the main deck in thickness varying from 8.7 inches to 6 inches. The speed is low for ships of this class, the expectation being that with 23,000 horse-power and Parsons turbines, a speed of 19.25 knots will be secured. Next in importance is the *Démocratie* class (1903) of four ships. They are of 14,900 tons displacement and 19½ knots trial speed. The 11-inch belt tapers to 9 inches forward and 7 inches aft. Above this is a 10-inch belt tapering to 5½ inches at the ends. The protective deck is 2¾ inches. Four 12-inch guns of 50 calibers length are mounted behind 12 inches of armor in two turrets; and ten 7.6-inch guns are carried, six of them in single-gun turrets above the spar deck; two in casemates forward on the main deck, and two in casemates aft on the gun deck. The ships of this class have the same high freeboard as the *Danton* class, and as in them the armor protection is admirable. Their battery, however, is light in comparison to that of battle-ships of the same date in foreign navies. The two battle-ships *Republique* and *Patrie* (1901-2), on which the *Démocratie* class are an improvement,

have similar armor protection; but the battery is less powerful, the four 12-inch guns being of an earlier 45-caliber pattern, and the secondary battery consisting of eighteen 6.4-inch 45-caliber guns, this latter being a much less powerful piece than the 7.4-inch. The 6.4s are mounted in six 2-gun turrets above the spar deck, and in six casemates, two forward on the main deck abreast of the conning-tower, and the other four amidships on the gun deck. These two are 19-knot ships. In the 50-caliber model of 1902 as mounted in the *Démocratie* class, the shell weighs 731 pounds, the velocity is 3000 feet a second, and the penetration at 8000 yards is 9 inches. Not satisfied with this, the French have brought out a 50-caliber 12-inch piece, known as the 1906 model, which, it is said, will be the most powerful 12-inch gun in existence, and will form the main armament of ships of the *Danton* class.—*Scientific American.*



BATTLE-SHIP "DANTON." "DREADNOUGHT" CLASS OF SIX SHIPS.
Displacement, 18,400 tons. Speed, 19.25 knots. Coal, 2000 tons. Armor: Belt, 10 to 6 inches; two 3-inch decks; side armor, 10 to 6 inches; main turrets, 12 inches; secondary turrets, 8.7 inches. Armament: Four 50-caliber 12-inch; twelve 50-caliber 9.4-inch; sixteen 3-inch; ten 3-pounders. Torpedo tubes, 2. Complement, 753.

The French armored cruiser *Ernest Renan* has just carried out her full power steam trials at Toulon. The contract provided for the development of 36,000 horse-power and a speed of 23 knots, with an economical coal consumption, but the trials gave satisfactory results of a development of 37,700 horse-power and a speed of 24.24 knots. These figures, it is stated, have never before been attained in any navy by an armored ship with reciprocating engines.—*United Service Gazette.*

The French have lately been fairly busy demolishing some of their old ironclads. The old monitor *Tempête* was fired at by the Mediterranean fleet at the end of August. Exact details of the firing are not obtainable, but substantially the results were as follows: (1) The superstructure was blown entirely to pieces. (2) The mast was grazed by a number of projectiles which eventually brought it down. (3) The port side was fired at, and the unarmored parts absolutely "honeycombed—with hits" a series of neat little holes. The starboard side—the side away from the hits—was

badly damaged by shells bursting after getting into the ship. This side seems to have burst most of the shells. (4) The armor was several times hit, but in no case penetrated. (5) The range was considerable—8000 yards according to some accounts. (6) The captains of guns fired first and secured 16 hits out of 40 rounds. Their successors got an average of 13 hits out of 80 rounds.

The old battle-ship *Admiral Duperré* was fired at and sunk by the Toulon forts, but details were kept confidential, as special projectiles were employed.—*The Engineer.*

A large committee has been formed under the chairmanship of Vice-Admiral de Jonquières to prepare a scheme for the reorganization of French naval administration. A writer in the *Yacht* describes the existing system as incoherence itself. Numerous modifications have been introduced from time to time which have undermined it, and there has been tinkering everywhere. One order has added something to its predecessors, and one circular has followed another with mutual contradictions, often anulling other circulars partly or altogether. Still greater has been the error of forgetting the principles of specialization, by burdening executive and other officers with excessive administrative duties. The new committee comprises many distinguished officers, including Commissary-General Rouchon-Mazerat, who has long experience; but the writer in the *Yacht* thinks the Minister might have done better than to appoint a committee, which he believes will be useless in regard to the administrative reform of the navy. It may do good service if it affirms the principle that naval officers should be disembarrassed of all occupations which interfere with their duties.

But the *Moniteur de la Flotte* considers that a good deal has been done lately to introduce reforms affecting various branches of the navy, while other questions are still being discussed. The new regulations with regard to pay have been brought into force. There is also a new decree with relation to the internal economy of ships. Many complaints came from the Mediterranean squadron, while the Northern squadron was unprepared for change. The staff adopted a compromise, and its proposal has been approved by the Superior Council of the navy. It is expected that the scheme for creating unity of origin for officers of the victualling department, administrators of the Inscription Maritime and the functionaries of the central administration will be presented forthwith to the Chamber. The decree for the reorganization of the professional services of the navy has been completed for several months, but apparently it will not be brought into force until the scheme for reorganizing the administrative services is in operation.—*Army and Navy Gazette.*

FRENCH SUBMARINES AND SUBMERSIBLES.—The submarine is beginning to lose some of the prestige it has so long enjoyed in France as a valuable unit in naval defence. The fiction that the submarine is capable of keeping even the most powerful enemy at a safe distance was encouraged three years ago, when the official report upon the Mediterranean maneuvers stated that the whole of the squadron had been sunk by the submarines from Toulon, and from that moment dated the wholesale construction of submarines and submersibles, public opinion being so strongly in favor of these craft that many millions of francs have been devoted to them. Recently, however, some maneuvers were carried out off Cherbourg, in which the armored cruisers *Marseillaise* and *Dupetit-Thouars* were attacked by ten submarines. It appears that some of the submarines could not discharge their torpedoes at all, and only one hit was recorded during the maneuvers. As a matter of fact, the smaller types of craft, which constitute the majority of the forty-eight submarines and submersibles now in service, have scarcely any value at all, but the later submersibles of heavier tonnage, with a few of the submarines, are capable of giving a good account of themselves, although naval officers are not disposed to exaggerate their

importance as fighting units. The object of the isolated maneuvers being carried out from time to time is to allow of a selection of the most suitable types of submersibles and submarines, the best results so far being apparently obtained with the latest types of big submersibles; but while this course of selection tends in favor of a larger tonnage, it eliminates from the flotilla the small submarines which have cost the country so much during the past few years.—*The Engineer.*

RECENT MANEUVERS CARRIED OUT BY FRENCH TORPEDO FLOTILLAS.—The following account of some exercises carried out by the French Northern torpedo flotillas was contributed to *La Vie Maritime* by M. Charles Bos, the editor of that valuable little service periodical. M. Bos was until recently one of the Deputies for Paris; he has twice served as the reporter to the chamber of the Naval Budget, is recognized in France as an authority on naval matters, and on the present occasion was the guest of Vice-Admiral de Jonquières on board the *Indomptable*.

By order of Vice-Admiral de Jonquières, Permanent Inspector-General of Flotillas, all the torpedo-boats, together with the Channel and Atlantic divisional destroyers, were concentrated at Brest about the 10th of last June. In order to allow these small vessels to carry out sham attacks and make use of torpedoes with shock heads, the coast-defence-ship *Indomptable* was commissioned at Cherbourg, and as soon as ready for sea she proceeded to Brest, where she arrived about the same date as the flotillas. Before the arrival of Vice-Admiral de Jonquières, the united flotillas carried out various exercises, and practiced firing their torpedoes. Owing to the *Indomptable* developing some defect it was not until the 22d of June that the Inspector-General hoisted his flag on board her, and that the program of maneuvers and attacks, drawn up by him with the assistance of the general staff, could be commenced.

In addition to the flag-ship, there were lying in Brest roadstead 45 destroyers and torpedo-boats, under the orders of the commandants of the five flotillas of the Channel and Atlantic:

Brest flotilla: Commandant, Capitaine de Frégate Tonnelier.

Dunkirk flotilla: Commandant, Capitaine de Frégate Pumperniel.

Cherbourg flotilla: Commandant, Capitaine de Frégate Mercier de Lostende.

Lorient flotilla: Commandant, Capitaine de Frégate Delguey de Malavas.

Rochefort flotilla: Commandant, Capitaine de Frégate Louël.

Before giving an account of the maneuvers and night attacks, which were most interesting, we must make some observations of a general nature.

The *Indomptable* was commissioned, as we have said, at Cherbourg. The shortness of men made itself very evident, since contingents from the crews of all the ships in reserve had to be drawn upon to man her, and as the men had on their cap ribands the name of the ship to which they properly belonged, the *Indomptable* had the appearance of having picked up the survivors of a naval disaster. If a foreigner had seen this fortuitous crew, he would not have failed to say that our naval decadence was irremediable. When is the solution of this great question of the effectives going to be taken in hand? It is not possible that the present state of things can continue. Not only is there a deficiency of seamen when it is necessary to commission a ship in the reserve, but ships supposed to be fully manned are some ten to fifteen per cent short of their proper complements.

It is quite clear that our flotillas are well-trained and in a condition to work together when massed. We have never before attempted so large a concentration as that which Vice-Admiral de Jonquières has carried out, and we congratulate him heartily on his happy idea, and on his having realized it. As we have so often pointed out, the dispersion of our torpedo-boats between the principal coast ports is a huge blunder. It is a mere

electoral move, and from no naval point of view can it be defended. To imagine that our great commercial ports will be defended against hostile aggression, and that our coast will not be ravaged because a number of small torpedo-boats are dotted about all over the place, would be equivalent to saying that our eastern frontier would be inviolable if, instead of being concentrated in forts or prepared positions, our soldiers were ranged side by side along the whole length of the frontier.

So let us hope that the concentration effected by Vice-Admiral de Jonquières will show the general staff the necessity of starting afresh in a definite fashion. The Rochefort, Lorient, Brest and Cherbourg flotillas, as well as the presence of some torpedo-boats at St. Malo and Havre, have no *raison d'être* in present circumstances. It is in the vicinity of the Straits of Calais that all these small units should be concentrated: at Dunkirk, Calais and Boulogne. There, even in broad daylight, except in thick weather, an attack *en masse* should be successful against an enemy's fleet—one may divine whose—which wished to force a passage. Let us say *à propos* of this, that by action *en masse* we do not wish to say that all the destroyers and torpedo-boats should act at the same time, but concentrated, as we have indicated, they would attack by *échelons* in such a way as to harass the enemy and inflict upon him serious losses, while affording each other mutual support.

Next, it is evident from these maneuvers that some unification of the tactics to be employed by torpedo-boats is called for. At the present time each flotilla commandant has his own system which he believes—and it is only human nature—to be the best. In each of these tactical methods there is clearly something good to be extracted. But everybody's views have hitherto failed. It is necessary to unify and have only one system, and the concentration of the torpedo forces will singularly facilitate the drawing of one up.

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The program of the maneuvers and the attacks was admirably conceived. Vice-Admiral de Jonquières always kept in view the hypothesis of war, and for several days the amalgamated flotillas carried out as far as possible what they might actually have had to do in war.

The flotillas weighed at 6.30 p. m. on Monday, the 22d of June, to proceed to the position in the sector to which each had been allotted, which would be crossed by an enemy at a certain hour of the night. The *Indomptable*, representing this enemy, quitted the shelter of the roadstead some two hours later. The first attack was to take place after sunset, about 9.45 p. m. Naturally the *Indomptable* was steaming without lights. The sea was smooth and the night without any moon, but perfectly clear.

The Rochefort flotilla was the first to carry out, off Toulinquet, an excellent attack, both on the port and starboard side. The divisional boat, followed by three units, passed to starboard, whilst the others, coming up at intervals of a minute, made as if they wished to pass to port of the ship. The first torpedo-boats were sighted when about a thousand yards off. A shot from one of the starboard guns announced to the flotilla that they were discovered, and the search-lights were turned on each of the vessels. These steamed past at a distance of scarcely four hundred yards, firing one after the other a shot from one of their guns to indicate that they had fired their torpedoes, and afterwards turning on their position lights. At the moment that the divisionaire signalled firing her torpedo, the first vessels of the rest of the flotilla were sighted on the port side at a distance of seven or eight hundred yards. A shot from the port gun announced that they were seen; the search-lights were turned on, and torpedoes nominally discharged. Had it been real war, it is probable the *Indomptable* would have been struck.

Further on, and when steering for the Chaussée de Sein Light, the Brest flotilla, which was more numerous, took up the attack, which was excellently carried out, and would have achieved, like the others, some results

in war. Some miles from the light of the Raz de Sein the *Indomptable* altered her course and steered towards Ushant Light. Immediately afterwards the Lorient flotilla made a successful attack. Further out at sea came the turn of the Cherbourg flotilla. Finally, the *Indomptable*, having altered course in order to gain her anchorage in the Cove of Morgat, in Douarnenez Bay, the Dunkirk flotilla attacked her when off Cape de la Chèvre.

The maneuvers of the night were finished. It was almost 1 a. m. The *Indomptable*, with all her fires alight, made straight for the Cove of Morgat, escorted and followed by the forty-five small vessels, all showing their lights, which gave to the anchorage, which was reached at 2.30 a. m., the appearance of a pretty Venetian fête.

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The next day, in broad daylight, new maneuvers, representing other night attacks, were carried out. For these maneuvers the *Indomptable* and five destroyers in line ahead and flanked to port at a distance of about 400 meters (437 yards) by four torpedo-boats representing destroyers, were supposed to represent a battle squadron. The 36 units which remained were divided into three flotillas.

According to the prearranged scheme, the *Indomptable* was visible to the flotillas at distance of 5000 meters (3 miles, 188 yards), but they, on their side, were not considered in sight until within 1200 meters (1312 yards).

The attacks were well carried out. The *Indomptable* first stood towards Ushant. The first flotilla attacked her on both sides simultaneously. The three last ships in the line would have been in danger.

The *Indomptable*, after passing some miles off Ushant, altered course and steered for the Chaussée de Sein. The second attack was made in three divisions: the one on the right was composed of the fastest vessels, that on the left of the slowest, the center division being made up of the remaining units. The left and center divisions maneuvered so as to pass to port, whilst the other went to starboard. The admiral, in order to deceive the enemy, altered his course to port.

The *Indomptable* then presented her bow to the left division. At this moment the units of this division formed line abreast in order to pass to port, during which the *Couleuvrcine*, the leader of the center division, had to go astern to avoid colliding with one of the torpedo-boats of the left division. Meanwhile, the right division, coming up at full speed on the starboard side of the enemy's line, attacked the other five ships. Had the attack been a real one, the squadron would have been badly damaged.

The third attack was made about 6 p. m. at the moment when the *Indomptable* and the squadron, having altered course, were steering towards the Bay of Douarnenez. In two divisions this time, the attack was made from both sides simultaneously.

The squadron and the flotillas anchored together just in front of Morgat. After dinner other night attacks were made.

The flotillas weighed again at 8.30 p. m., in order to station themselves along the route which the *Indomptable* and the five destroyers, representing the enemy's battle squadron, would have to follow. The sea was quite calm, but with some fog in the Iroise Channel. The squadron quitted their anchorage a little later. The weather was very clear, so that the flashes from the numerous lighthouses along the coast showed up with extreme brilliancy, leading one to suppose that a thick fog would come on suddenly. There were five attacks, each flotilla acting independently.

The *Indomptable* and the squadron retraced the route they had previously followed, but in the opposite direction. All the attacks were well carried out. However, when the last one was being made by the Dunkirk flotilla, towards one in the morning, and a little before the entrance of the Goulet was made, the night had come on so thick that nothing could be seen. Already one of the other flotillas had passed very close to the squadron without sighting it, although it had been seen itself. The Dun-

kirk flotilla, coming down on the starboard bow, was only sighted when a few hundred yards off, standing across the *Indomptable's* bows just ahead. A catastrophe being possible, the *Indomptable* showed her lights, and she was only just in time. The *Durandal* crossed her bows at full speed at a distance of barely 60 meters (65 yards) from her ram; the torpedo-boat which followed, ported her helm, the *Indomptable* did the same, so that the former was able to pass to port of the flagship. The third boat followed suit, but passed further to seaward. The other vessels, in line ahead, attacked the squadron to starboard.

The end of the exercises was then signalled, as well as permission to the flotillas to return to Brest. The *Indomptable* reached the entrance of the roads at 2 a. m. Then the fog suddenly came down, and after having passed the Mingant Rock, the Minion Light could scarcely be seen. The ship anchored in Boscanvel Cove at 2.30 a. m., and did not reach her buoy in the harbor until 7.30 a. m. of the 24th. Several flotillas entered the harbor, but the Rochefort one, which had the furthest to go, passed the night in Bertheaume Cove.

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Such were the maneuvers, and they are worthy of notice for more than one reason. They were well conceived and well carried out. They have constituted an excellent preparation for battle, and there has been no mishap to deplore, thanks, as we feel bound to say, to the skill and training of the commandants of the destroyers and torpedo-boats, as also to the caution of Vice-Admiral de Jonquières and the *sang-froid* of Commandant Didelot. A simple accident—a rush of water into a condenser—compelled one of the Brest torpedo-boats to quit the scene of operations in tow of one of the tugs.

Everything passed off admirably. The night attacks, however, call for a few reflections.

In the first place it seems clear that the true moment for attack by a torpedo-boat is at the end of the twilight or at the commencement of the dawn, when there is no moon. At such times the night, in the latitude of Brest, is very dark. One can see nothing.

Next, we are forced to the opinion that the best method of attack is that which consists of acting against the port and starboard side of a ship or fleet in line ahead, but not simultaneously, an interval of a minute and a half or two minutes being left between the two attacks, so as to take advantage of the very short time during which the attention of the enemy is entirely occupied on the side where he has sighted the torpedo-boats. It is the second part of the attack which has some chances of success on the unwatched side. Consequently, it is necessary that each group of torpedo-boats should consist of at least five units, or at most six, because it is necessary to make allowance for possible, even probable, loss. With a larger group, the risk would be run of the others being sighted, brought under the search-lights and sunk before being in a position to act.

In the third place, it is indispensable that to the first attack should succeed several others in order to keep the enemy continually on the *qui vive* and harassed until he has sustained serious losses. Concentration should therefore take place in the latitudes where the enemy may logically be expected to operate. The concentration being made—and it ought to be carried out during peace—each group will attack one after the other, it being understood that the attacks follow each other rapidly.

In addition, a torpedo-boat, in order to arrive at a convenient distance for discharging her torpedo without being seen, should make no noise nor betray its presence by any smoke. From this point of view our training torpedo-boats can be used for a long time to come, because great speed is unnecessary. At night, without lights, an enemy's squadron, having to fear a torpedo attack, will navigate at slow speed. Our torpedo-boats, even those steaming only fourteen knots, will be able to take part in an attack

on a squadron under those conditions, because at this speed there is neither noise nor smoke, when the stoking is carefully regulated.

Finally, we must remark that maneuvers of the kind of which we have been speaking and which constitute the real preparation of the torpedo-boats for war, should be frequently carried out. The visits of the permanent inspector-general of the flotillas, however, are very rare, as he has other duties to perform.

It follows from this that the inspector-general should be a commander-in-chief, having the same advantages and the same privileges as the chief of a squadron. The concentration of his forces being made, partly in the Mediterranean, partly in the Channel, two ships should be placed at his disposal for the exercises of the various flotillas. The flotillas in the Channel and Mediterranean should be each commanded by a captain, who would explain the ideas and tactics of the commander-in-chief. The latter, periodically hoisting his flag on the ship of the Commandant of the flotilla —the *Chateaurenault* and *Guichen* would suit admirably—would exercise the torpedo-boats and judge of their state of training.

Common sense, as well as strategy, call for these measures being taken with as little delay as possible. Submarines and torpedo vessels would then have the necessary plan of operations, and would be able to render us the service we expect from them.—*United Service Institution.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Nassau	18,000	Wilhelmshaven.	Launched March 7, 1908.
Westfalen	18,000	Bremen.	" July 1, 1908.
Rheinland	18,600	Stettin.	" Sept. 24, 1908.
Ersatz Baden	18,600	Kiel.	Building.
" Oldenburg	18,600	Wilhelmshaven.	Ordered.
" Beowulf	18,600	Bremen.	"
" Siegfried	18,600	Kiel.	"
Armored Cruisers.			
Gneisenau	11,600	Bremen.	Under trial.
Scharnhorst	11,600	Hamburg.	" "
Blücher	15,000	Kiel.	Launched April 11, 1908.
F	17,000	Hamburg.	Building.
G	17,000	"	Ordered.
Protected Cruisers.			
Emden	3,800	Kiel.	Launched May 27, 1908.
Ersatz Greif	4,300	Danzig.	Building.
" Jagd	4,300	Stettin.	"
" Schwalbe	4,500	Kiel.	Ordered.
" Sperber	4,500	"	"

According to *Le Yacht*, the armaments of the German *Dreadnoughts* are as follows: *Nassau* type, twelve 11-inch, twelve 4.7-inch; *Ersatz Baden* type, fourteen 11-inch, twelve 6.7-inch, or fourteen 4.7-inch; *Ersatz Beowulf*, twelve 12-inch, twelve 6.7-inch; and the displacements, 18,000, 19,000 and 20,000 tons, respectively. The same authority gives the cruisers as follows: *E* (Blücher), ten 11-inch; *F*, twelve 11-inch and some 4.7-inch; *G*, ten 12-inch; the displacements being 15,000, 19,000 and 20,000 tons.—*The Engineer.*

The dock-ship *Vulkan* has recently been placed in commission in the German Navy. The distinguishing feature of the *Vulkan* is its peculiar form. The vessel itself consists primarily of two hulls, both resembling ships linked together fore and aft above the water-line by steel girders made up of angles and plates. This linking or joining together is done in such a manner that a torpedo-boat or submarine riding at the surface can steam between the two hulls. When the small craft is in this position tackles and

crane-hooks can be lowered from the dock-ship, and the little vessel can be lifted out of the water and docked. After that, from both of the inner sides of the dock-ship, beams are swung under the smaller vessel, so as to form a platform on which she may rest. The beams are fastened by hinges to the inner side of the dock-ship. That is to say, they are fastened to the inner side of one of the hulls, and are pulled up against the inner side of the other hull as far as it is advisible to raise the docked boat. These beams play no actual part in the raising of a vessel, that action being performed wholly by the cranes and tackles on the dock-ship. The center of the dock-ship is free, and the submarine or torpedo-boat may be raised as far out of the water as desired. The hoisting or lifting apparatus is arranged on two double portals or bridges built up of lattice girders, the bases of which girders rest on the decks of the two hulls. These girders also serve as a rigid connection between the two hulls.

The means of propulsion of the vessel are interesting, for neither reciprocating engines nor turbines but electric motors are employed for driving the two propeller shafts. Current is delivered to the motors by two independent turbine generator sets. If the vessel is to steam slowly one generator set only is run. All the switches and controlling mechanism for the entire machinery are operated from the bridge, so that no inter-communication between the commanding officer and the engine-room is necessary. Steam is generated in four Mehlhorn water-tube boilers.

One of the purposes for which the vessel is destined is to serve in salvage operations for sunken submarines, the necessity for such a salvage ship having become more and more apparent as the development of submarine practice has progressed. The trials of the ship have, so we gather, been very satisfactory—so much so, in fact, that a second and larger ship of the same type is under consideration for the other great German naval bases.—*The Engineer.*

The German high sea fleet has been reorganized. The battle-ship *Hannover* left the second squadron and joined the first squadron as the second ship of the *Deutschland* class. In this ship Vice-Admiral von Holtzendorff hoisted his flag, which had previously flown in the *Wittelsbach*. The latter ship remains in the first squadron, and has become the flagship of Rear-Admiral Ingenohl. The second squadron consists exclusively of 13,200-ton battle-ships. In the first squadron there is not the same homogeneity, there being two ships of 11,150 tons, four of 11,800 tons and two of 13,200 tons. In the first squadron the establishment of men is 5420, and the total displacement 95,000 tons, while in the second squadron there are 5,640 men, and a total displacement of 105,600 tons. In armament the second squadron is superior, the heavy guns being thirty-two 11-inch, while in the first squadron there are only eight of that caliber, and twenty-four 9.4-inch. The shell of the heavier gun weighs 240 kg. and of the lighter 140 kg., while the respective initial energies are 10,000 meter-tons and 5000 meter-tons.—*Army and Navy Gazette.*

The reorganization of the German high sea fleet has been accomplished. On September 22 the battle-ships *Kaiser Wilhelm II* and *Kaiser Wilhelm der Grosse*, which have been in the fleet since 1900-1, were put out of commission to be reconstructed. This reconstruction is to consist of a reduction of 360 tons weight, by removing four 15-centimeter guns from the lower casemates, cutting down superstructures, smokestacks and military masts, as has already been done to the *Kaiser Barbarossa* and is being done at the present moment to the *Kaiser Friedrich III.*

Two of the *Kaiser* class remain in the fleet, the *Kaiser Barbarossa* and the *Kaiser Karl der Grosse*, the latter not yet reconstructed.

The reorganization took place on October 1. The *Deutschland* remains the flagship of the fleet and continues to form part of the second squadron. The two other flagships are: for the first squadron, the *Hannover*, and the

second, the *Preussen*. It is to be noted that the high sea fleet remains composed of 16 battle-ships, despite the recent additions to it. It would appear that the greatest efforts are now to be made to improve the reorganization of the reserve forces. In fact, according to the law of June 14, 1900, which in this respect was not changed in 1906 or 1908, the German fleet should comprise 4 squadrons, of 8 battle-ships each, and 2 battle-ship flagships, plus 4 so-called replacement battle-ships (one for each squadron). The coast defence ships of the *Siegfried* class (8 units) are provisionally to constitute one of these squadrons.

The first and second squadrons form the active fleet, called the high sea fleet. They are to comprise, according to the scheme of 1900, 17 battle-ships, inclusive of a battle-ship flagship, 4 armored cruisers and 12 small cruisers; that is one cruiser for each battle-ship. This plan is almost realized, but there still is lacking the battle-ship flagship and 6 small cruisers.

For the third and fourth squadrons, the German fleet has available only 4 ships of the *Brandenburg* class and 8 small *Siegfrieds;* the depôt ships being the *Ægir* and the *Frithjof*, at Danzig, for the 8 *Siegfrieds* and the *Kurfürst Friedrich Wilhelm* for the four *Brandenburgs*, at Wilhelmshaven.

It would be possible to add, in case of mobilization, to the first squadron, the *Schwaben*, 17th battle-ship, and soon the 3 reconstructed *Kaisers* will permit raising to 7 the number of high sea battle-ships of the squadron of reserve at Wilhelmshaven (third squadron).

The entry into service of the 2 *Nassaus* in 1910 will further increase by two the number of available battle-ships.

The torpedo-boats of the 1907 series, *V150 and V161* (12 units), are now all launched, and 8 of them have at their trials reached or exceeded 30 knots. These vessels, the largest of their class which the German Navy has yet had built—displacement 670 tons—are 72.1 meters long, 7.8 meters wide and 3.1 meters draft, with 2 screws and 10,250 H. P. Their coal supply, which reaches 175 tons, should give them a radius of action of 3300 to 3500 miles. Their armament consists of three torpedo-tubes of 45 centimeters; two 88-millimeter guns and two machine guns. The crew consists of 4 officers and 79 men.—*Moniteur de la Flotte.*

The *Moniteur de la Flotte* of October 31 states that the ships to be laid down in 1908 have now all been ordered. The armored cruiser *G* is to be built at Hamburg, where *F* is already in course of construction. The 12 destroyers have been ordered from three firms; they are of 616 tons, with the turbine machinery to give 30 knots speed.

An imperial order has been issued, giving engineer officers in the navy the same rank and precedence as officers of the executive branch, and to mark the change in their position these officers are for the future to wear the same swords as those of the last named.—*United Service Institution.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Bellerophon	18,600	Portsmouth.	Under trial.
Téméraire	18,600	Devonport.	Launched Aug. 24, 1907.
Superb	18,600	Newcastle.	" Nov. 7, 1907.
St. Vincent	19,250	Portsmouth.	" Sept. 10, 1908.
Collingwood	19,250	Devonport.	" Nov. 7, 1908.
Vanguard	19,250	Vickers.	Building.
Foudroyant	19,250	Portsmouth.	To be laid down in 1908.
Armored Cruisers.			
Invincible	17,250	Newcastle.	Under trial.
.....	17,250	Devonport.	To be laid down in 1908.
Cruisers.			
Boadicea	3,350	Pembroke.	Launched May 14, 1908.
Bellona	3,400	"	Building.

Preparations for building the fourth armored cruiser of *Invincible* type were begun at Devonport immediately after the launching of the *Collingwood* on November 7; her keel will not be formally laid, however, until February.

The new battleship to be laid down at Portsmouth will retain the 12-inch gun, and will, in spite of rumors to the contrary, be merely an improved *St. Vincent*. Slight modifications to the positions of the turrets are arranged for in order to allow all ten guns to fire on one broadside, and the middle center-line turret will be carried up higher than the after one, so that its guns can bear right astern, as in the *Minas Geraes* and *South Carolina*.

In addition to being fitted with two big tripod masts instead of one, ships of the *Bellerophon* class are to have a special tower built between the two after turrets, where the *Dreadnought* carries her mainmast. This tower will be somewhat on the lines of the American skeleton mast, or like a miniature Eiffel Tower.—*The Engineer.*

THE "BELLEROPHON."—The *Bellerophon* has begun her official trials and will carry out the usual tests at one-fifth and three-fourths power for endurance, an eight-hours' full-speed run, and several additional progressive power trials to afford data in connection with the design of future ships. She is the second of the *Dreadnought* class, and in various stages there are five others, two of which will be completed before March next, while the other three are to be ready for the pennant by March, 1910. The *Bellerophon*, designed by Sir Philip Watts, K. C. B., director of naval construction, was built at Portsmouth Dockyard, and is 490 feet long, 82 feet beam and when drawing 27 feet has a displacement of 18,600 tons. The machinery is of the Parsons steam-turbine type, and was constructed by the Fairfield Shipbuilding and Engineering Company, Limited, Govan, N. B.

Her machinery, like that of the *Dreadnought* and other large warships, includes two cruising turbines and two high-pressure and two low-pressure turbines, all for driving the ship ahead, with two astern turbines. The total power is 23,000 shaft horse-power, which, it is anticipated, will give the vessel a speed of 21 knots. The *Bellerophon* was laid down on December 3, 1906, and it is expected that she will be in commission within two years from that date.—*Engineering.*

THE "ST. VINCENT."—The *St. Vincent*, launched at Portsmouth on September 10, is the first of three battle-ships of the 1907-8 programme to take the water. Laid down on December 30, 1907, she is an improved *Dreadnought*, displacing 19,250 tons, against the earlier vessel's 17,900 tons. She will, however, carry the same main armament—ten 12-inch guns—the principal improvement in outward characteristics being in the anti-torpedo-boat equipment, which will consist of 4-inch 25-pounders, where the *Dreadnought* carries only 3-inch 12-pounders. The speed remains the same—twenty-one knots—and the new vessel will be driven by Parsons turbines, of 24,500 horse-power. The *St. Vincent* should be ready for commissioning by the end of 1909, and she will be followed on the slip at Portsmouth by the battle-ship *Foudroyant*, provided for in the navy estimate for the current year. It will be noted that the construction of the *St. Vincent* up to the date of launch occupied eight calendar months and eleven days, which is about the same rate at which the *Bellerophon* was built, when the additional weight of material built into the *St. Vincent* is considered. The *Bellerophon* was laid down on December 3, 1906, and launched on July 27, 1907, making seven calendar months and twenty-four days. Both these vessels were built during the usual dockyard working hours, whereas the *Dreadnought*, which was laid down on October 2, 1905, and launched on February 10, 1906, the work being carried on during day

and night, was launched in four months and eight days. The *St. Vincent* has a length of 500 feet, her beam is 84 feet and draft 27 feet.—*Page's Weekly.*

Le Yacht states that the *St. Vincent* class will be armed with 12-inch Mark XI guns of 50 calibers length, and that they will carry 80 rounds per gun, of which 20 per cent will be A. P., 20 per cent lyddite and 60 per cent common shell. Their twenty 4-inch guns are to have 150 rounds apiece.

The *Gladiator* has been docked, and an examination of her hull reveals the fact that the whole of the side of the ship over the coal bunkers, from the upper deck to well below the water-line for about 50 feet, is sheared clean away. Everyone must be satisfied that this great salvage feat has been accomplished successfully, and the greatest credit is due to the association and all concerned in its performance. How much it has cost has yet to be assessed, but it cannot be much less than £60,000 or £70,000, while considerably more than that sum would be required to make the vessel again effective. It can scarcely be maintained that the expense already incurred, and that which would be necessary to repair and refit the vessel, would be repaid by her restoration to the active list. On the other hand, the money spent in salving the ship may give an adequate return in the experience which has been bought with it. It is manifest, for example, that when salvage operations are determined upon it is far wiser to put them in the hands of a private association like that which has undertaken this work than to attempt their performance with the material at the disposition of the Admiralty. It is possible also that the naval constructors may find in the condition of the vessel useful data and replies to some of the problems which have been raised by improvements in the direction of under-water attack. It is a great feat that has been accomplished, not only in raising the vessel when many unforeseen difficulties had to be surmounted, but also in bringing her safely to Portsmouth and placing her in dock. It has only been, of course, by the hearty co-operation of the officials of the salvage association with those of the dockyard at Portsmouth that a successful termination of their skilful efforts has been arrived at. It would be interesting to learn what the market value of the ship is at the present time, and if, as is more than likely, she is now sold it should not be long before we learn this.—*Army and Navy Gazette.*

THE NEW "BOADICEAS."—The *Bellona*, the first of the new *Boadiceas*, will be of 3404 tons, against 3353 for the *Boadicea*. She is to be given a trifle more beam and a little more horse-power; otherwise there will be no difference. She is being built at Pembroke and specifications have been issued for five cruisers of the *Boadicea* type. Six Clyde firms, five English yards and one Belfast firm have been invited by the Admiralty to tender for the cruiser, tenders being due at Whitehall on November 9.

Regarding the naval work to be immediately placed with private builders namely, the construction of 14 destroyers and five unarmored cruisers—specifications for the destroyers are already in the builders' hands. The destroyers will have special sea-going qualities and turbine machinery of 11,000 H. P. The designed speed will be 27 knots. The First Lord of the Admiralty stated in Parliament that these destroyers would have only 27 knots speed and use coal for fuel.

Portable blast screens of horseshoe shape in plan are to be fitted to the *Inflexible* class on the forward and after barbettes to protect the men at the 4-inch guns on the roof from the effect of the side barbette guns when fired fore and aft. As these screens are to be about 17 feet deep, they increase the size of target enormously, and must form most efficient shell traps.—*The Engineer.*

THE "LORD NELSON" AND "AGAMEMNON."—The *Lord Nelson* is 15 feet shorter than the *King Edward VII*, and 80 feet shorter than the *Dreadnought* class, so that she will be more easily accommodated in harbors and graving-docks. The displacement is about the same as the *King Edward VII* class, and 2000 tons less than the *Dreadnought*. The armor protection is equally effective in the *Lord Nelson* and *Dreadnought*, but the armament is essentially different. While the *Dreadnought* has ten 12-inch breech-loading guns, the *Lord Nelson* is fitted with four of these 12-inch weapons, and in addition has ten of 9.2-inch caliber. There are those who hold that ships of the *Agamemnon* and *Lord Nelson* class might, under certain conditions, be found superior in battle to the *Dreadnoughts*, because of the greater rapidity of fire by the 9.2-inch guns. The *King Edward* has four of these weapons, in addition to four 12-inch guns, the remainder of the armament being made up of 6-inch quick-firing guns. The 9.2-inch gun has proved very efficient in recent battle practice. Thus the 12-inch gun, under the very severe conditions now prevailing, has given an average for the whole of the British practice of 0.4 hits per minute, whereas the 9.2-inch gun gives 2.01 hits per minute. Thus, although the 12-inch gun

	King Edward VII Class.	Lord Nelson Class.	Dreadnought Class.
Length B. P.	425 ft.	410 ft.	490 ft.
Breadth moulded....	78 "	79 ft. 6 in	82 "
Draft.....	26 ft. 9 in.	27 ft.	27 "
Displacement.....	16,350 tons	16,550 tons	18,600 tons
Speed, designed.....	18½ knots	18 knots	21 knots
I. H. P., designed	18,000	16,750	23,000
Coals, normal	950 tons	900 tons	900 tons
Coals, bunkers, fuel.	2150 "	2200 "	2700 "
Main armament.....	4 12-in. B. L.; 4 9.2-in. B. L.; 10 6-in. Q. F.	4 12-in. B. L.; 10 9.2-in. B. L.	10 12-in. B. L.
Secondary battery...	14 12-pdr. 12 cwt.; 16 3-pdr.; machine boat and field guns	24 12-pdr. 18 cwt.; 8 3-pdr.; machine boat and field guns	16 4-in. Q. F.; machine boat and field guns
Submerged torpedo tubes.....	Four	Five	Three

fires an 850-pound shot, and the 9.2-inch gun a projectile of only 380 pounds, the possible weight of shot in a given time from the lighter caliber gun is considerably greater than from the 12-inch gun. In other words, the *Lord Nelson* could, according to the average results for the past year, from each broadside, register 1.6 hits with 850-pound projectiles and 10 hits with the 350-pound projectile; whereas the *Dreadnought* would only achieve 3.2 hits with 850-pound projectiles. The striking efficiency, or destruction per hit, is after all the most important consideration, and it must be remembered that at the 3000 yards range the 12-inch with uncapped shot may penetrate 17 inches of Krupp armor, while the modern 9.2-inch gun can only get through 10½ inches; in other words, each blow from the 12-inch gun has 70 per cent more effect, so that if the measure of efficiency is the extent of destruction, the *Dreadnoughts* have the advantage. At the same time, the higher rapidity of fire is a factor which cannot be ignored. As regards the armament for repelling torpedo attack, the later *Dreadnoughts* have again the advantage, as they mount sixteen 4-inch quick-firers, whereas the *Lord Nelson* class have only twenty-four 12-pounders.—*Engineering.*

WARSHIP ACCIDENTS.—Serious accidents in the British and foreign navies have been rife of late, and the recent disaster on the *Latouche Tréville* has brought forward the question of accidents on warships in general, and has led to the suggestion that a comparison of such calamities in different navies would be of interest. It is possible to obtain official information on

this subject with regard to the British Navy, as a parliamentary return was recently issued, giving the number of accidents to vessels from the first day in 1901 down to May 27, 1908. During this period the number of ships and other craft of war which met with accidents amounted to 442, 16 of which were totally lost. The total does not include a picket boat of the *Edgar*, the steamboat and pulling cutter of the *Vernon*, the gig of the *Defiance*, a submarine mining vessel and a steam cutter. The original expenditure on the ships and other craft of war totally lost in the term of seven years and five months, including guns and naval ordnance stores, amounted to £1,951,000 in round figures, whilst the number of lives lost as a result of accidents reached 408, or .92 per accident. Many of the accidents did not involve any loss of life, but merely caused material damages. This is shown by the statement that in the six years ended with 1906 no fewer than 278 vessels which had been in accidents had to be docked for repairs, the greater portion of the work having been carried out in the Royal dockyards. It is impossible to compare these figures with similar statistics relating to any other navy, but a Parisian newspaper has just published a list of the accidents to French vessels of war between August, 1900, and September, 1908, including the explosion on the *Latouche Tréville*. The list is, of course, unofficial, and it does not cover the same ground represented by the British return. Taken, however, as it stands, the list merely summarizes twenty-one accidents in the period of slightly over eight years, the material damage being £3,400,000, and the loss of life 288 officers and men. The explosion on the *Jéna* in Toulon harbor alone was responsible for 105 lives of the total, and the sinking of the transport *Vienne* for 52, whilst the cruiser *Brennus*, which was wrecked on the Portuguese coast in August, 1900, caused the loss of 43 lives. The fact that only a comparatively small number of accidents is attributed to the French Navy in a period of eight years is doubtless due to the unofficial source from which the figures emanate, and to the circumstance that they solely refer to wrecks, explosions of boilers and projectiles, collisions and breakage of screws. It is, therefore, impossible to draw any comparison or conclusion from the two sets of figures, as the one is evidently incomplete, whilst the other set is detailed.—*The Engineer*.

ACCIDENTS DURING MANEUVERS.—The return of naval casualties, specifying for each year from 1901 to 1907 all the accidents and casualties occurring to ships during maneuvers or tactical exercises ordered by the Admiralty, cannot be considered otherwise than as a satisfactory document. By far the larger number of casualties, seventy-five in all, were of a very minor character, and principally relate to mishaps to machinery. There were altogether twenty-seven collisions, that is to say, cases in which two ships came together to the damage of one or both of them. But here again the actual damage was not generally of a serious character, and only in one instance did the accidents lead to loss of life. This was when a man was drowned at the time of the collision of the *Decoy* with the *Arun* off the Scilly Islands in August, 1904. The most serious accident of all was that which occurred in the *Blake* in August, 1903, when the crown of the boiler furnace came down and three men lost their lives. There were during the eight years ten cases of vessels touching ground, but not much damage was done to any of these ships, with one exception, when the *Viper*, in August, 1901, ran on the rocks between the Casquets and Alderney in a fog and was totally lost. The exact purpose to be served by the production of this return is not clear, but we presume it was asked for at the instance of Mr. Thomas Gibson Bowles, who wrote to the *Times* charging the Admiralty with the loss of many ships and lives owing to their allowance and encouragement of naval maneuvers and sham attacks at night without lights. The indignant protest of Mr. T. Gibson Bowles does not receive much support from the return asked for by his son.—*Army and Navy Gazette*.

A return has been issued giving the number of courts-martial held and summary punishments inflicted on seamen during 1907. The number of courts-martial held was 202, and the number of persons tried was 107 persons of the seaman class, 77 of the non-seaman class, and 28 Royal Marines afloat, making a total of 212 persons, against 221 for the previous year. Of offences against discipline, there were seven cases of desertion, 137 cases of striking and attempting to strike superior officers, 12 of threatening language to superior officers, 16 of wilful disobedience, 26 of behaving with contempt to superior officer, 15 of improperly leaving place of duty, 14 of absence without leave, 22 of drunkenness and 34 acts to the prejudice of good order and naval discipline. Among the offences punishable by the ordinary law there were 41 cases of theft and embezzlement, four of disgraceful conduct, and one of perjury. The total number of offences dealt with was 334. The number of summary punishments during the year include five dismissals with disgrace, 80 dismissals from the service, 2856 cases of imprisonment, 908 cases of disrating, 8246 prisoners condemned to the cells, and 107,255 minor punishments. The number of men borne in the ships was 111,838 in 1907, as against 111,518 in the previous year, and while the total number of offences against superior authority has declined from 225 in 1906 to 191 last year, the cases of drunkenness have risen from 9 to 22.—*Army and Navy Gazette.*

An order in council, published in the *London Gazette* of October 27, authorizes the Admiralty, at their discretion, to allow any officer who is likely to profit by a longer period than the 12 months now allowed for study in Japan with a view to qualifying as interpreters, to remain in Japan on full pay for two years, subject to the condition that there shall not be more than three officers at any one time studying the language, and that they shall be included in the total number of 20 now allowed to be abroad at the same time for the study of modern languages.—*Army and Navy Gazette.*

The Admiralty have approved of all battle-ships carrying stern lights, and as a consequence, these lights become a recognized service fitting, and will be fitted by the artificers of the ships.

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Roma	12,625	Gov't Yard, Spezia.	Launched Apr. 21, 1907.
Napoli	12,625	" " Naples.	" Sept. 10, 1905.
Vittorio Emanuele	12,625	" " Castellamare.	Under trial.
A.	19,000	" " "	Building.
B	19,000	.....	To be laid down in 1908.
Armored Cruisers.			
San Giorgio	10,200	Gov't Yard, Castellamare.	Launched July 27, 1908.
San Marco	10,200	" "	Building.
Pisa	10,200	Orlando Works.	Launched, Sept. 15, 1907.
Amalfi	10,200	Odero Works.	" May 5, 1908.
B	10,200	Leghorn.	Building.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Satsuma	19,200	Yokosuka.	Launched Nov. 15, 1906.
Aki	19,800	Kure.	" Apr. 15, 1907.
Huki	19,800	Yokosuka.	Building.
Armored Cruisers.			
Ibuki	14,600	Kure.	Launched Nov. 21, 1907.
Kurama	14,600	Yokosuka.	" Oct. 21, 1907.
Protected Cruiser.			
Tone	4,100	Sasebo.	" Oct. 24, 1907.

The battle-ship *Satsuma*, now in hand at the Yokosuka Dockyard, is a sister ship of the *Aki*, which is approaching completion at Kure. The 11¾-inch armor plating is about to be placed in position. The twenty-six guns, of which four are of 12-inch caliber, have been manufactured at Kure. These vessels displace 19,500 tons, and are 482 feet long, with 82 feet 6 inches beam and 27 feet 6 inches draft. Their engines are of 24,000 H. P., and the speed is to be 20.5 knots. The torpedo armament comprises five discharges. The hull of the *Satsuma* has been built, completely framed, with the skin-plating, and the deck, as well as the aftermast, and the boilers will soon be on board. The ship will proceed from Yokosuka to Kure to be completed, and she is expected to be ready for sea early next year. The armored cruiser *Kurama*, a sister ship of the *Ibuki*, is now receiving her internal fittings at Kure, and will be completed in 1909. She displaces 14,600 tons, and is 450 feet long with 75 feet 6 inches beam. The engines will have 22,500 horse-power for a speed of 22 knots. The armament comprises four 12-inch and eight 8-inch guns, and five torpedo-tubes. After the war many changes were made in certain of the ships. The *Mikasa* has now, like the *Kashima* and *Katori*, four 12-inch, four 10-inch and ten 6-inch guns. It is intended to lay down two armored cruisers, according to the *Kokumin*, *A* and *B*, of which the following particulars are given: Displacement, 18,650 tons; 44,000 horse-power; 25 knots' speed; length, 545 feet; beam, 80 feet; draft, 26 feet 6 inches; thickness of main armor plating, 7 inches. The armament will comprise ten 12-inch guns, a number of 6-inch and ten 4.7-inch. One of these ships is to be laid down at Kure. —*Army and Navy Gazette.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Emperor Paul I.....	16,900	St. Petersburg.	Launched Sept. 7, 1907.
Andrei Pervozvannui.....	16,900	"	" Oct. 20, 1906.
Evstafi	12,500	Nicolaiev.	" Oct. 1906.
Ivan Zlatoust	12,500	Sevastopol.	" May 13, 1906.
Armored Cruisers.			
Bayan.....	7,800	St. Petersburg.	Launched Aug. 15, 1907.
Pallada	7,800	"	" Nov. 10, 1906.
Protected Cruiser.			
Outchakoff	6,750	Sevastopol.	Building.

THE "RURIK."—The armored cruiser *Rurik*, which has recently left the works of Messrs. Vickers, Sons & Maxim on acceptance by the Russian naval commission, is the first large vessel to be completed for the Russian Navy since the close of the war with Japan. The designs were originally completed before the close of that conflict, but as a result of the lessons of the war they were considerably modified, the principal alterations taking the direction of greater structural strength and protection against underwater attack.

The *Rurik* is 490 feet long between perpendiculars, with a beam of 75 feet and a normal draft of 26 feet, giving a displacement of 15,200 tons. She has a very powerful armament, consisting of four 10-inch guns, 50 calibers long, twin-mounted in barbettes fore and aft on the center-line. Each of these guns can be worked through 35° of elevation and 5° of depression, while the forward guns can be trained 45° abaft the beam, and the after guns 45° before the beam. There are also eight 8-inch 50-caliber guns, twin mounted in barbettes on the quarters of the ship, having an angle of fire of about 170°. For repelling torpedo attack there are twenty 4.7-inch guns of 50 calibers length. Sixteen of these are placed within an armored battery in the center of the ship, separated from each other by specially hardened armor. This battery, being on the upper deck,

enables the secondary armament to be placed higher above the water-line than usual. There are four 4.7-inch guns aft, also behind armor, and to counteract the effect of raking fire, three armored bulkheads have been fitted. There are also twelve 47-millimeter, quick-firing guns, and two 18-inch submerged torpedo-tubes, one on each bow.

The armament of the ship was subjected to very severe tests, at the instance of the Russian officers who superintended the trials on behalf of the naval commission. For each caliber of gun mounted in the ship a "test" weapon was specially built, and from each of these there were fired 100 rounds with full charges. Following this, 30 rounds were fired from two of the 10-inch guns, and two of the 8-inch guns, and fifteen from all the others, at varying angles of elevation and training. All the guns are operated by electrical mechanism, and the guaranteed rate of fire is two rounds a minute from the 10-inch, three from the 8-inch and eight from the 4.7-inch guns, representing an aggregate discharge of 16,384 pounds of metal a minute, of which the 10-inch and 8-inch guns account for 9184 pounds.

The *Rurik* is, for her size, very efficiently protected. She has a main belt 12 feet deep extending for 270 feet of her length, and this belt is 6 inches thick, the material being Krupp steel. At the bows the thickness is reduced to 4 inches, and at the stern to 3. The central battery of 4.7-inch guns is protected by 3 inches of armor, the strake extending for a length of 200 feet and including all the heavy-gun barbettes. These barbettes are constructed of 7¼-inch Krupp steel plates, while the walls of the conning-towers, of which there are two, are 8 inches thick. There are two protective decks having a total thickness of 4 inches, and the bases of the funnels are protected by armor casings. The whole of the machinery and magazines below the water-line are surrounded by armored walls extending from the main deck, through the protective decks right to the bottom of the ship, and since this is in addition to the usual double skin, the ship is practically armored from the keel to the upper deck.

The machinery of the *Rurik* consists of two sets of four-cylinder quadruple-expansion engines, steam being supplied by twenty-eight Belleville boilers. The latter work at a pressure of 285 pounds to the square inch, which is reduced to 250 pounds at the engines. There was no full-speed stipulation in the contract, the conditions being that the ship should be able to steam an easy 21 knots with only 75 per cent of her boiler power. This was done for three hours, and then a ten-hour run at full power was made. The results of these and of the other steam trials are shown in the following table:

	Mean of 30 Hours at 12 Knots.	Mean of 30 Hours at 19 Knots.	Mean of 10 Hours at 21 Knots.	Mean of 3 Hours at 21 Knots, with 75% Boiler Power.	Mean of 10 Hours at Full Power.
Steam pressure, pounds per square inch..	196	261	269	273	280
Vacuum, inches	27.12	27	26	25.8	26.2
Revolutions per minute	75.6	123.85	138.48	138.3	141.6
Indicated horse-power	3,039	13,359	19,355	18,953	20,675
Number of boilers in use.....	8	21	28	21	28
Air pressure in stokeholds, inches.....	0.13	0.3	0.31	0.58	0.36

The *Rurik* differs considerably in appearance from the British cruisers of the *Indomitable* type. The huge tripod masts are missing, the Russian vessel having only a light signalling-mast with a searchlight platform low down. The fire-control stations, which are high up on the masts of the

British ships, are comparatively low in the *Rurik*. They are constructed of 5-inch armor, and are situated a little fore and aft of the masts. The ship came through all her trials with uniform success, and will be a formidable addition to the Czar's navy. It is probable that she will be the last Russian warship to be built abroad, as the naval commission decided last year that all new ships were to be laid down in home yards.—PERCIVAL A. HISLAM in the *Scientific American*.

Ueberall repeats the statement that the German shipbuilding yard of Blohm & Voss at Hamburg has been successful with its plans for the battle-ships intended to be laid down for the Russian government. Plans were secured for the four ships from various constructors, including the Putiloff, St. Petersburg, Nevsky and other Russian yards, some of them in relation with English contractors, the Vulcan yard at Stettin, the Stabilimento Tecnico at Trieste, Ansaldo, Armstrong & Co. at Sestri Ponente, Fairfield Shipbuilding Company, Messrs. Laird Bros., Messrs. Vickers & Maxim, Messrs. Armstrong, and in France the shipbuilding yards at La Seyne, Havre and others. It appears from the German statement that Messrs. Blohm & Voss, the Baltic yard, St. Petersburg, Messrs. Ansaldo & Armstrong and Messrs. Vickers & Maxim have been successful with their plans, but no particulars seem to be available as to the number or character of the vessels, and probably some time will elapse before they are put in hand. They are to be built in Russian yards.—*Army and Navy Gazette*.

A Lloyd's telegram from Libau on October 12 stated that the Russian man-of-war *Oleg* had gone ashore near Steinort during a fog and was sinking. A salvage steamer had gone to her assistance. A later report states that the *Oleg*, although seriously injured, was hauled off and towed to Libau.

SPAIN.

Tenders have been submitted for the new Spanish Navy. The battle-ships are to be of about 15,000 tons, 19½ knots speed and about 425 feet long. Three destroyers of 360 tons and 28 knots, and 24 torpedo boats of 180 tons and 26 knots, as well as four small gunboats of about 1000 tons, complete the proposed fleet. The large ships are to be built at Ferrol, and the smaller vessels at Carthagena. Both dockyards are to be entirely renovated, and it is estimated that the work will occupy at least eight years.—*The Engineer*.

UNITED STATES.

VESSELS BUILDING.

No.	Name. *Battle-ships.*	Speed. Knots.	Where Building.	% of Completion Nov. 1.
26	South Carolina	18.5	Wm. Cramp & Sons.	65.9
27	Michigan	18.5	New York Shipbl'g Co.	74.9
28	Delaware	21	Newport News.	50.3
29	North Dakota	21	Fore River.	58.8

The *North Dakota* was launched on November 11. She is the largest battle-ship afloat or building in the world, although the *Florida* and *Utah*, which are about to be laid down, will be about 500 tons larger yet. The *North Dakota, Delaware, Florida* and *Utah* are practically sister ships; they will be the most most powerfully-armed ships, as well as the best protected by armor, in existence when they are completed; they are the only ships yet laid down, excepting the two Brazilian ships, *Minas Giraes* and *San Paulo*, having a broadside fire of ten 12-inch guns.

CONTRACTS FOR DESTROYERS AWARDED.—The Secretary of the Navy has awarded the contracts for the construction of the ten torpedo-boat destroyers authorized in the last session of Congress. The awards are: Two boats each to the Fore River Shipbuilding Co., the New York Shipbulding Co., the Newport News Shipbuilding & Drydock Co., the Bath Iron Works and the William Cramp & Sons Ship and Engine Building Co. The contracts to the Fore River and Cramp plants are for the construction of vessels on their own plans for hull and machinery; the contracts to the other firms are for the construction of vessels on the department plans.

The amounts of the contracts are: Fore River Shipbuilding Co., $610,000 each; Newport News Shipbuilding Co., $620,000 each; Bath Iron Works, $644,000 each; William Cramp & Sons Co., $664,000 each; and New York Shipbuilding Co., $665,000 each.

The department's plans and specifications were for vessels of about 742 tons displacement, the hull and machinery being designed for a guaranteed speed of 29.5 knots, giving bidders at the same time the option to submit plans of their own machinery. The Cramps will construct 30-knot boats, and the Fore River Co. 29.5-knot craft with their own plans for machinery.

NEW COLLIERS FOR UNITED STATES NAVY.—The Maryland Steel Co., Sparrows Point, Md., has been awarded the contract for building three new colliers for the United States Navy.

Each of the colliers will be 385 feet long, 53 feet beam and 32 feet 6 inches deep. There will be 10 hatches, each 12 feet by 28 feet long and to each hatch will be a specially designed derrick for the rapid discharging of coal when loading battle-ships and cruisers at sea and at the government coaling stations. The engines and boilers will be aft, in order to give all the space possible for taking on of cargo. The engines will be of the triple expansion type, which will be supplied with steam from four Scotch boilers, each 15 feet in diameter and 11 feet long, tested to stand a working pressure of 200 pounds of steam to the square inch. The vessels will be of the twin-screw type and when completed must develop 12 knots an hour. They must carry, exclusive of their bunker coal and fittings, 7200 tons of coal.

NAMES FOR NEW NAVAL VESSELS.—Thirty new naval vessels have been assigned names by President Roosevelt. They are ten torpedo-boat destroyers, fifteen submarines and five colliers.

The destroyers, which were authorized by the act of Congress of May 13, 1908, are named *The Hiram Paulding, Percival Drayton, Francis A. Roe, Edward Terry, George H. Perkins, Andrew Sterrett, Edward R. McCall, William Burrows, Lewis Warrington* and *John Mayran*, respectively.

The fifteen new submarines will be named *Stingray, Tarpon, Bonita, Snapper, Narwhal, Grayling, Salmon, Carp, Barracuda, Pickerel, Skate, Skipjack, Sturgeon, Thrasher* and *Tuna*.

The colliers recently authorized will be named the *Jupiter* and *Cyclops*. The colliers to be purchased will be called the *Vulcan, Mars* and *Hector*.

Rear-Admiral Hiram Paulding was distinguished for gallant service in 1812 and was assigned by President Lincoln to put the navy in a state of efficiency in 1861. Capt. Percival Drayton was Admiral Farragut's fleet captain in Mobile Bay. Rear-Admiral Roe saw important service in the China seas and in the Civil War. Commander Edward Terry was commended for service during the Civil War at the battle of Mobile Bay. Rear-Admiral Perkins was commended by Admiral Farragut as an efficient officer, and Lieutenant Andrew Sterrett commanded the *Enterprise* and captured a Tripolitan cruiser in 1801, threw her armament overboard, gave her crew one spar and a sail and let them go. Capt. Edward R. McCall, Lieutenant Burrows, Captain Warrington and Midshipman Mayran performed distinguished naval service, for which they were publicly commended.—*Nautical Gazette.*

ORDNANCE AND GUNNERY. TORPEDOES.

TARGET PRACTICE IN THE ITALIAN NAVY.—In pursuance of a scheme for making uniform the gunlayer's regulations, and for promoting specialization among officers qualified as artillerists, the Italian Minister of Marine established, at the beginning of this year, a school of target practice on the battle-ship *Sardegna*. The results of the combination of scientific study and practical training realized by the scheme is shown by this year's returns of target practice just to hand. The quickness and accuracy of firing attained shows the increased efficiency in the Italian Navy, and it will be of interest to record some of the more noteworthy of the results. The gunlayer's prize-shooting took place with ships steaming on a track marked by buoys, at a speed of 14 knots, firing at a target 23 feet by 56 feet for heavy and medium calibers, and 10 feet by 30.5 feet for small guns. Some ships averaged 75 per cent of hits, whilst the average of the whole was 60 per cent. The following table shows the record performances of some guns:

Calibers in inches.		Rounds fired.	Hits.	Time in seconds.	
Heavy guns	13.5	2	2	153	Target, 1288 sq. ft. Range, 2700-2900 yards.
	12	2	2	35	
	10	2	2	38	
Secondary guns	8 (turrets)	2	2	30	
	8 (casem.)	2	2	14	
	6	4	4	27	
	4.7	4	4	16	
Small guns	3	6	5	24	Target, 306 sq. ft. Range, 1370 yards.
	2.25	6	5	16	
	1.85	6	5	22	

The results obtained by tactical groups are still more interesting. The target was formed by a torpedo-boat carrying one large target, 23 feet by 82 feet, and towed at a speed of 24 knots.

At the close of the autumn maneuvers, the second division, composed of the armored cruisers *Garibaldi*, *Varese* and *Ferruccio*, at a range of 4400 yards, fired four rounds from each secondary, and one round fom each heavy gun, making an aggregate of 109 rounds for the whole broadside. The result was: 21 hits on the torpedo-boat's hull, 57 on the canvas, a total of 78 hits, or 71.5 per cent.

In the prize firing of single ships at moving targets, towed at a relative speed of 24 knots, some ships averaged 75 per cent with medium-sized guns, and with a speed of 14 knots, 40 per cent of hits with heavy guns, the range being in both cases 6500 yards.

These results afford an instructive comparison with those of this year's French target practice—*écoles à feu*—which commenced at the Salins d'Hyères at the end of August. The returns for the squadron battle-practice show a percentage of 34.8 hits, the average of thirteen battle-ships at a range of 4900-5500 yards, and a speed of 12-15 knots, with speed and course of the ship unknown to the gunnery officer, was 20 per cent hits. The *Jules Ferry* headed the list with 33.1 per cent, the worst performances being those of the *Liberté*—13.8 per cent—and the *Republique*—11.7 per cent.—*The Engineer.*

The British Admiralty have decided, with a view to increasing the efficiency of Whitehead practice in torpedo-boats and destroyers, to institute an annual torpedo-firing competition for prize money, which is to be based on a scale of £1 per boat per annum, and is to be calculated from

January 1 to December 31 in each year. Divisions of six boats, or as near that number as convenient, are to compete together. The distribution of prize-money is left to the discretion of the officer in charge of the flotilla, subject to the approval of the commander-in-chief. Three schemes have been laid down for the first year of the competition, and the commodore (T), captains (D), or the senior officers of flotillas have the option of selecting whichever scheme they consider the most desirable. For the purposes of the competition, torpedo craft will be divided into three classes, according to the torpedoes carried—18-inch new pattern, 18-inch old pattern and 14-inch. The Admiralty direct that the instructions for running torpedoes as laid down in Vol. III of the *Torpedo Annual* are to be strictly observed. Reduced settings are not to be altered. The officers in command of the various flotillas are to make the necessary arrangements for providing umpires and marking-officers, and for picking up torpedoes, and may also issue any local orders considered necessary. The competition is to take place during the summer or autumn months. The following flotillas are to take part: Eastern and Western destroyer flotilla, Portsmouth, Nore, Devonport and home fleet torpedo-boats and destroyers, Mediterranean and China destroyer flotillas and Sheerness, Chatham, Portsmouth, Devonport and Gibraltar flotillas of torpedo-boats. On conclusion of the competition each flotilla is to forward a detailed report to the Admiralty, accompanied by any suggestions for the future development of this exercise. *United Service Gazette.*

The battle-ship *Revenge*, tender to the Whale Island Gunnery School, has been engaged in a series of experiments to test how far a projectile is deflected from its course when it strikes the water, and at what depth it becomes ineffectual. A special target was prepared and towed at various ranges by the *Seahorse*, while the guns of the *Revenge* directed their fire upon it. The target is constructed upon steel caissons which extend a considerable distance beneath the surface of the water, and on which the effect of the shot will be recorded.—*United Service Gazette.*

On September 22 a caisson representing the under-water hull of the new French battle-ships (*Danton* class) was tested at Lorient by exploding against it a Whitehead torpedo. The caisson weighed 300 tons, and was sunk by the explosion; the torpedo seems to have been placed in contact with it, not fired at it.

The *Moniteur de la Flotte* states that the 11-inch guns to be installed on the new German battle-ships will fire a 760-pound projectile with 2850-f. s. muzzle velocity. Although this is a great improvement over the 11-inch guns already afloat in the German Navy, it does not compare favorably with the 12-inch guns of English, Japanese and American battle-ships. The latest English and Japanese 12-inch guns on ships in commission fire an 850-pound shell with 2700-f. s. muzzle velocity, and the 12-inch 50-caliber English gun, being built for the *St. Vincent*, will probably have a service velocity of 2850 f. s.

RECENT FRENCH GUNNERY EXPERIMENTS. Translated from *Le Yacht.*—The Mediterranean squadron having finished its firing at the coast-defence ship *Tempete*, she was towed to Toulon on August 29. Her superstructures were riddled with shots. On the port side, where she was attacked, nothing can be seen but the holes made by the projectiles, but on the starboard side, where they emerged, the skin-plating is very much torn. The belt was not pierced, but bears the mark of several projectiles which were unable to overcome it. The mast was cut by numerous projectiles. As regards the general results of the firing, it is said that of 40 rounds fired by gun captains, 16 struck, and of those fired by others, 13 out of 80 were hits.

There is a good deal of discussion of the recent squadron firings at the *Tempete*. In the course of this firing several things went wrong. On the *Patrie* two 12-inch guns, elevated in order to clear the bore with compressed air by means of the Marbec appartus, could not be brought back to the firing position. On the *Justice* there was a flareback in the 12-inch turret, due to hasty opening of the breech and too slow action of the Marbec appartus.

On the whole, the results of the firing seemed to show improvement. The battle-ships armed with 7.6-inch guns did particularly well. This gun fires rapidly considering its caliber. Moreover, it is perhaps the most thoroughly developed of all our naval artillery. As stated by Mr. Thomson, the percentage of hits was 24 in place of the 16 per cent of last year, and the "rendement" increased from 8½ to 16.

The battle-ship *Admiral Duperré* was used as a target for the shore batteries. She received several impacts from the 9.5-inch guns, which made considerable holes below the water-line and caused her to sink in the shallow water where she was. These tests were particularly interesting because the P shell, a special and secret projectile, which is a veritable torpedo-shell acting below the water-line, was used. The *Admiral Duperré* will be docked and a commission will examine her before she is repaired for the purpose of new tests.

The armored coast-defence ship *Tonnerre* is also soon to be used as a target, by the squadron of the north. She has been anchored in shallow water so as to be easily raised if sunk, which, however, is not probable, as the largest gun used against her will be the 7.6-inch.

FATAL GUN MISHAP ON BOARD THE GUNNERY-SHIP "COURONNE."—A serious mishap, caused by the premature explosion of the charge of a 6.4-inch Q. F. gun during the closing of the breech-block, occurred on board the gunnery-ship *Couronne* on August 12, while at target-practice off Salins-d'Hyères, which resulted in six men being killed, seven badly hurt and fourteen others more or less seriously injured.

It appears that practice had been carried on from the gun—model 93-97—during the forenoon, an average of six rounds a minute having been fired. The gun had become very hot, and at 11 a. m. practice was interrupted, to be resumed again at 1 p. m. The charge of these guns is in two parts, the cartridge itself and a copper case, containing the primer, an arrangement which has always been considered a very unsatisfactory one. Thirty-four rounds had been fired after the resumption of the practice, and the breech-block was being pushed home, when there was a tremendous burst of flame, and it was blown violently to the rear. The priming, which was being brought up to the gun for the next charge, was ignited, as well as two other charges at the rear of the guns. All the men who were on this part of the deck were struck down by the terrible blast of this hurricane of flame.

Four officers who were in rear of the gun, by some miraculous chance, only received superficial burns, while between Sub-Lieutenant Mouren, who was in charge of the firing, and Midshipman Thévenard, who was taking the time, in the small space of two paces which separated them four men lay dead. Two other officers, who were going through the gunnery course, were thrown down, but only received slight contusions.

The outburst of flame set fire to the deck, the flames from the burning of which were visible to other ships lying in the roads; but there was no panic, and the fire was fortunately soon extinguished. As the *Couronne* is an old wooden steam line-of-battle ship, and her decks like tinder, had the fire gained a hold, the safety of the ship might well have been endangered. —*La Vie Maritime*, *Le Moniteur de la Flotte*, and *Le Temps*. (Translation from *United Service Institution*.)

FATAL GUN MISHAP ON BOARD THE FRENCH ARMORED CRUISER "LATOUCHE-TRÉVILLE."—We regret to have to report another terrible gun accident, which has taken place on board the *Latouche-Tréville*, tender to

the gunnery-ship *Couronne*, by which 13 men have lost their lives, and 2 have been very seriously wounded.

The following account of this last accident, by an officer on board the *Latouche-Tréville*, who was an eye-witness, is given in the *Temps*:

"On Tuesday, 22d September, *tirs d'honneur* were being carried out from the *Latouche-Tréville* off Toulon, for the purpose of selecting the best shots from the men under instruction to receive certificates of captains of guns. The guns used were three 14-cm. (5.4-inch) and one of 19-cm. (7.6-inch) in the after turret, and it was in this latter that the explosion took place. The ship had been steaming along a firing-base, and had arrived at the end of the run, and was turning 16 points to go back again, and bring the starboard guns into action. The 'cease-fire' was sounded, and as there would be a period of about three minutes before recommencing, advantage was taken of this delay to change the gun's crew; the gun, which was loaded, being left, in accordance with the instructions, with the breech unlocked. The officer in charge of the first gun's crew warned his relief that the gun was loaded, and after this no one can say exactly what happened; but hardly had the new crew entered the turret—not yet quite evacuated by the old crew—when an appalling explosion took place, blowing the breech-block of the gun through the door of the turret, and lifting off the roof-shield, 95-mm. (3.6-inch) thick, which fell on the deck, killing one man, and then bounded overboard. A jet of flame also descended the ammunition hoist to the magazine, luckily without exploding the latter. The inside of the turret, in which every man was killed, presented a horrible sight. The marvelous escape of the two officers is due to the fact that they had just before moved out of the turret to give room for the new crew to pass in.

"It was first thought that on account of the force of the explosion more than one charge must have ignited, but this was not the case, the other cartridges being found intact.

"One theory is that the new crew, on entering the turret, opened the breech, and that the draft of air into the gun caused gas left in the chamber by previous shots to ignite and fired the charge, while the breech-block, not being closed, was naturally blown out. M. Thomson, Minister of Marine, on receipt of the intelligence, at once proceeded to Toulon, and has been most unceasing in his attentions in visiting the wounded at the Saint-Mandrier Hospital, who he has decorated with the military medal. One of these two, unfortunately, did not live long to wear this distinction, and has since succumbed to his injuries, bringing the number of deaths up to 14."

The breech-block, which was blown into the sea by the explosion, has since been recovered by the divers from a depth of 22 meters (72 feet), the percussion-tube was found in place, and showed that it had been fired. This discovery would seem to put out of the question the theory of the explosion having been caused by a return flame, and the disaster would now appear to be due to neglect on the part of one of the gun's crew to remove the tube, according to the regulations, before opening the breech, and the tube was probably fired by tension of the tube-lanyard (which may have caught in some way), caused by the withdrawing of the breech-block. —*La Temps and La Vie Maritime.* (Translation from *United Service Institution.*)

FLAREBACKS IN THE FRENCH NAVY.—The "flareback" peril is not, by any means, confined to our own navy. The recent disaster on the French ship *Couronne*, due to this cause, when twenty-seven lives were lost, has been followed by a similar accident on the *Latouche-Tréville*, in which nine men were killed.* In discussing the accident, *Le Figaro*, of Paris, says that

* It seems to have been proved beyond much doubt that this accident was caused in the manner set forth in the last paragraph of the preceding article.—P. R. A.

the committee of investigation ordered to look into the explosion on the *Couronne* attribute the accident to a "retarded inflammation of the gases developed by previous charges." Two hypotheses were offered in explanation of the explosion. First, the ignition of the powder in the bore of the gun, either spontaneously or through the heat of the bore or of the residues at a high temperature; and second, the blow of the breech-block against the cartridge case in closing the breech. In either case, the projectile, offering a certain resistance to expulsion, remained in its seat, while the breech-block—closed but not yet locked, and consequently offering no resistance—was thrown back and broken, leaving a free exit to the gases escaping from the cartridge-case. These gases set off two other cartridges that the gun's crew held in readiness, and thus burned the personnel. These are the facts as found.

The artillery officers, standing on experiments made at the Servan-Livvy laboratory and the Gavres firing-ground, maintained that the primer had been exploded by the shock of the breech-block against the head of the cartridge-case. They based their conviction on the fact that such an explosion had been brought about by tests that had been most carefully supervised. The naval officers did not deny this; but they maintained that such an explosion was only produced by repeated blows of the breech-block against the cartridge-case, and never on a first blow. In addition, they maintained that, on the evidence of the survivors, this had not been the case in the accident of August 12. Furthermore, the reports on the incidents of the target-firing on the *Gueydon* in 1904, with her 6½-inch guns, model 93-96, that is to say, the same model as those of the *Couronne*, show that the phenomena occurring at that target exercise were identical with those marking the accident on the *Couronne;* and the cause as reported on investigation was attributed to a retarded reinflammation of gases developed by previous firing, the flame being communicated to the powder exposed bare in the cartridge-case, as the latter is left entirely open in front.

This proof, sustaining the contention of the naval officers, was singularly confirmed very shortly afterward by other incidents equally significant which occurred on board the *Justice*. In one of the 12-inch turrets of this battle-ship, just as the last part of the cartridge had been inserted in the chamber, a sheet of flame burst back; fortunately, the web of the cloth of which the cartridge-bag is made resisted the flame, but it was only thanks to this that no accident happened. Again, and a few days afterward, on one of the armored cruisers, just at the moment when the breech-block of a 6½-inch gun—identical with that of the *Couronne*—was closed *and locked*, the gun went off; on second sooner, and the accident of the *Couronne* would have been exactly repeated. In face of this assemblage of concurring facts, it was considered to be no longer possible to deny the existence of the flareback, that is to say, the retarded reinflammation of gases engendered by prior discharge, as the cause of the accident on the *Couronne*. There is more doubt as to the cause of the *Latouche-Tréville* accident; although the balance of evidence seems to point to the detonator having been struck prematurely as the cause of explosion.—*Scientific American.*

The first-class battle-ship *Jéna*, condemned for service after the disastrous explosion last year, is being repaired at Toulon to the extent of making her capable of floating, and to be used as a target. It is stated that the firing experiments will include (1) observation of the effects of projectiles fired at close range on the light armor and superstructure; (2) of the effect of bursting shells after penetration at long distances up to 6000 meters. The programme of firing will, however, be elaborated by a committee, to be presided over by Rear-Admiral Auvert, composed of a capitaine de frégate, two engineers, a chef d'escadron of artillery, a captain of artillery and two lieutenants de vaisseau.

THE DAVIS PROJECTILE TORPEDO.—Briefly stated, the difference between the standard Whitehead torpedo and the new Davis torpedo which recently underwent a very successful test is that the first carries a charge of gun cotton which is detonated agains the side of the ship at the instant of contact, whereas the latter carries, in addition, a smokeless-powder gun which at the instant of impact discharges a high-explosive shell into the interior of the ship where it is exploded by a short-time fuse. The destructive effects of the Whitehead torpedo are not as widespread nor so fatal as the great size of the charge, amounting in the latest torpedoes to over 200 pounds, would lead us to expect. In the Russo-Japanese War, ships that were struck by torpedoes were able to proceed to port, or move into some desired position for repairs, under their own steam. The disparity between the size of the charge and the extent of the damage is due to the fact that the energy of the gun cotton is let loose on the outside of the ship, immediately at the skin-plating. The latter is, of course, subjected to widespread damage, a large rent being invariably torn in the side of the ship; but it frequently happens that the damage is practically confined to the outer skin; the walls of the inner compartments proving sufficiently strong to resist the rush of gas and prevent the passage of any considerable amount of water beyond the one compartment affected. The object aimed

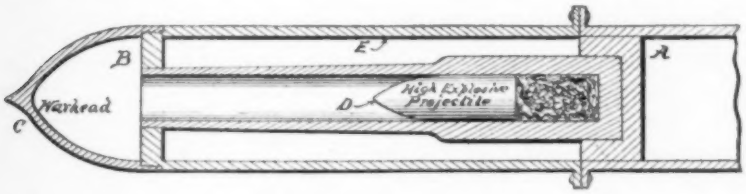

FIG. 1.—Section of Forward Portion of Torpedo, Showing the Gun with Its Projectile and Powder Charge.

at in the new torpedo, which is the invention of Lieut.-Commander Cleland Davis, U. S. N., is to attack not merely the outer skin of the ship, but the vitals of the ship itself—to enable the torpedo to carry its high explosive charge, or a portion of it, through the inner bulk-heads of the ship, where it can be detonated with the correspondingly greater destructive effect.

The means by which the above results are secured are shown very clearly in the accompanying diagram, Fig. 1, which represents approximately the interior construction of the forward portion of the torpedo. At the front is the usual war-head. Back of this is a section provided with two diaphragms, *A* and *B*, in which is mounted a light gun of large caliber, with a length of ten calibers, whose walls are less than an inch thick and which weighs less than 350 pounds. It is built of a vanadium steel for which a strength of nearly 250,000 pounds to the square inch is claimed, and it is the great strength of this metal in proportion to its weight which has rendered it possible to mount such a gun in a torpedo, and yet keep within the limits of prescribed weights and proper balance. The gun is loaded with a charge of smokeless powder and with a high-explosive projectile *D*. Projecting from the war-head is a short horizontal spindle provided with a small screw propeller. The instant the torpedo enters the water, the propeller begins to revolve on the spindle, and in so doing sets the mechanism in the proper position for firing the gun at the moment of contact of the torpedo with the side of the ship. At the instant the torpedo strikes, the powder-charge within the gun is ignited, and the projectile driven forward into the interior of the ship. If no fuse is employed, the shell will pass entirely through the vessel; but if a short-time fuse is adjusted, the shell may be detonated at any desired distance within the vessel, say either in

the center of the boiler-room, or in the engine-room or magazine, where its fragments will necessarily cause a large amount of damage. Also, the passage of the shell and its explosion will serve to open several of the compartments of the ship, and involve the flooding of a larger area than would be possible, or at least probable, if the torpedo were one of the ordinary type.

We present diagrams, showing the results of a test recently carried out at Fort Strong, Mass. A cylindrical caisson shown in the diagram, Fig. 2, was built to represent roughly the interior structure of a warship below the water-line. The barge from which the torpedo was fired was moored 120 feet from the target. The torpedo was slung on a trolley-wire, which was stretched from the barge to the target, in order to insure an accurate hit. The experiment was eminently successful. A huge hole was torn in the front face of the target, and the projectile passed through four separate steel bulkheads, each about an inch in thickness; passed out through the other side of the target; and landed in the mud 175 feet beyond. The

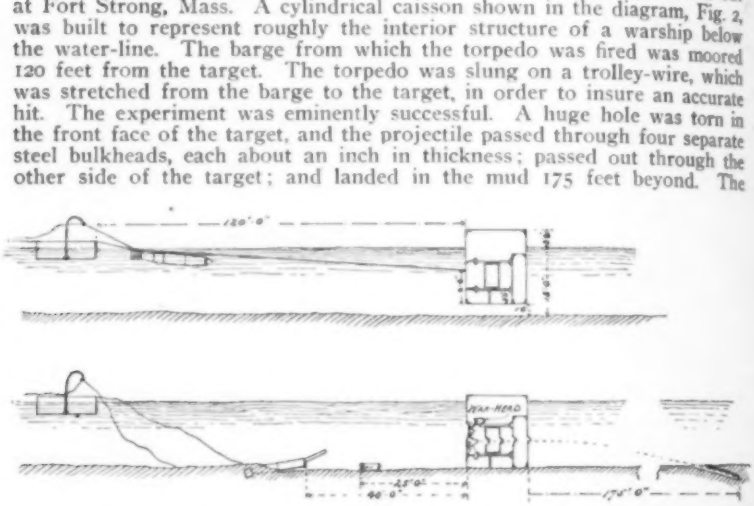

FIG. 2.—Diagram Showing the Trolley-wire by Which the Torpedo Was Directed to the Target, and the Condition of Target and Torpedo After the Attack.

reaction of the explosion drove the after part of the torpedo with the gun attached 40 feet to the rear, and the cylindrical portion of the torpedo which had inclosed the gun was driven 25 feet backward. The projectile did not explode, but even in this case the value of the gun was proved in its cutting a hole entirely through the structure.—*Scientific American.*

MARINE TURBINES AND GAS ENGINES.
LIQUID FUEL.

COAL OR OIL AS WARSHIP FUEL.—It is not at all unlikely that coal will still hold its own as a fuel for the boilers of warships, although there have been many prophecies as to its disappearance, since the introduction of oil. As a matter of fact it is rumored that the new destroyers of this year's programme, which are just being given out to contract, are to be fitted for the sole consumption of coal, and not for a combination of oil and coal such as the majority of both the large and the small ships in the navy are at present fitted for. There appears to be a large amount of wobbling at the Admiralty in connection with the fuel question, as some of our latest destroyers are fitted for oil consumption only. It may be that the Admiralty intend to have a test of economy and durability between two groups of these vessels, one group being fitted to consume oil only, and the other to consume coal. Yet one would imagine such tests were exhausted before oil was installed, as the only fuel, in some of our present boats. If a coal and oil experiment is to be carried out, it is far more likely that the

destroyers of this year's program are to be fitted with the suction gas engine, which would, of course, need coal only; and this need not be of the best quality. The *Rattler* experiment a few weeks ago has put the Admiralty in possession of much useful data; and possibly they feel justified in making a further experiment.—*United Service Gazette.*

It is a curious commentary on international marine engineering that just as Great Britain is discarding oil fuel for destroyers France and Germany are both adopting it in torpedo craft for the first time. Sufficient details of the British system of burning oil fuel have by now leaked out as to render the foreign designs less experimental than they otherwise would be. The objection to oil fuel is cost and difficulty of supply, but vessels like the *Swift* and *Cossack* are quite impossible without it.—*The Engineer.*

OIL-BURNING MONITOR "CHEYENNE."—The U. S. monitor *Cheyenne*, formerly the *Wyoming*, which was placed in commission at San Francisco last week, has been converted into an oil-burner, and oil tanks have been substituted in place of the coal bunkers. The monitor is now the first large vessel of the American Navy to burn oil. The outcome of a series of tests to be given the ship in the near future, if successful, may mean the changing of all of the larger vessels of the Pacific fleet into oil-burning vessels, as oil can be obtained so much easier on this coast than coal, and is so much cheaper.

After her trial trips are completed the monitor will be sent to Honolulu to act as station ship.—*Nautical Gazette.*

GAS-ENGINES IN H. M. S. "RATTLER."—For several years past the use of internal-combustion engines for the propulsion of ships has been discussed, more, however, from the academic than the practical point of view. It is a subject that gives scope for plenty of such discussion, for even supposing any kind of agreement to be reached on the main question, there is, as yet, room for endless differences of opinion as to the relative merits of the various types of gas and oil plants for marine purposes. Most of the points raised are such as can only be definitely settled by experiments on a practical scale, and until the results of such experiments are forthcoming no amount of theorizing will bring us any nearer the final solution of the problem. Up to the present, excepting the small craft coming under the heading of motor-boats, very little has been done toward the actual development of the marine internal-combustion engine. To carry out experiments on any adequate scale requires not only a firm conviction of the future of the system, and a very considerable amount of money, but also a fair prospect of finding a use, or a purchaser, for any vessel so equipped. Moreover, for the experiments to have any chance of success involves a combined knowledge of both gas-engine and marine work, which is not always to be obtained.

The rarity with which such a condition can be fulfilled accounts for the almost negligible number of attempts by the advocates of internal-combustion engines to put their ideas into practice. It is easy to point out the advantages of such engines for marine purposes, and there is always the chance, by so doing, of getting some of the credit which more properly belongs to the man who eventually attains success. Among the first who did really practical work on the subject was the late Herr Capitaine, of Frankfort, who a few years ago constructed several small tug and other boats propelled by suction-gas engines. These were designed for use on canals, but one of his boats, the *Emil Capitaine*, was tried in the Solent in 1905, and created considerable interest. She was only of 16 tons displacement and had a speed of 10 knots; she was probably the first suction-gas boat to appear in the open sea.

Following on Herr Capitaine's work, Mr. William Beardmore, of Glasgow, decided to extend the same principle to vessels of a really sea-going

type, for several designs got out by Mr. W. W. May, engineer of Messrs. Beardmore's naval construction works, showed that a very considerable economy might be obtained over steam-driven vessels. The producer plant and engine together weigh anything up to 25 per cent less than the steam plant for a corresponding power, and occupy less space. Moreover, the greater efficiency of the gas plant reduces the necessary bunker capacity, and allows more room for cargo. Messrs. Beardmore thereupon commenced the construction of a 500-horse-power suction producer and marine gas-engine, destined to replace the steam machinery of H. M. S. *Rattler*, an old gunboat used as a training-ship for the Royal Naval Volunteers on the Clyde. The *Rattler* is 165 feet long by 29 feet beam, and formerly contained a set of triple-expansion engines. The change to gas-engines was made by the influence of the Marquis of Graham, who is the commander of the Clyde Naval Volunteers, and who, moreover, takes a keen interest in all engineering progress. Thanks to his efforts, and the enterprise of the above-mentioned firm, not only have the Volunteers a vessel in which they make cruises away from their base, but engineers are furnished with the first example of a large marine gas-engine.

The engine on the *Rattler* is of the vertical single-acting open type, with five cylinders, and a fly-wheel abaft the first two. We illustrated this engine in our issue of April 13, 1906, before it was installed in the vessel, and hope shortly to be able to give full particulars of its construction. The ordinary four-stroke cycle is used, each cylinder being 20 inches in diameter, with a stroke of 24 inches, and developing 100 brake horse-power. The crank-shaft runs at 120 revolutions per minute. The pistons are not water-cooled, and the open framing renders the connecting-rods and cranks fully visible from either side. The design of the framing strikes one as exceptionally good. It is constructed entirely of steel plates and angles, the plating being curved round to form the crank-race, and continuing upwards on each side to support the cylinders. These latter, with their heads, are the only important details made in cast iron. The engine when running is perfectly steady, in spite of the apparent and actual lightness of the framing.

The valves are situated vertically in the cylinder-heads, the inlet-valves in a row on one side of the engine, and the exhaust-valves on the other. Each set is worked from a cam-shaft running alongside the lower end of the cylinders, the cam-shafts being driven by inclined bevel-geared lay-shafts from the aft end of the crank-shaft. The valves are all water-cooled, connections being made by flexible rubber tubes to a sort of cross-head on the stem. Low-tension make-and-break ignition is employed, each cylinder having its own magneto. Messrs. Beardmore consider this the most satisfactory for marine work on account of the absence of high-tension leads, and the apparatus on H. M. S. *Rattler* has justified this view by working faultlessly for the twelve months or more during which she has been in commission. Forced lubrication is used for the cylinders, but not elsewhere. Any cylinder can be shut off independently of the others, so that its valves, ignition, etc., can be examined, if necessary, while the rest of the cylinders are working.

Starting is affected by means of gas stored in reservoirs at a pressure of 95 pounds per square inch. This is turned on, and the engine moved by a bar. The compression-relief cams being in action, there is no compression in the cylinder, and the momentary automatic depression of a special starting valve allows the gas to enter immediately before the firing point. A baffle device of numerous thin plates prevents any possibility of a back-fire in the gas-pipe. Moreover, the mixture cannot be fired until the admission-valve is closed. As soon as the engine starts, the starting-valve gear and the relief-compression gear are, of course, put out of action. When, by the courtesy of the Marquis of Graham and the constructors of the machinery, we had the opportunity of having a trip in the *Rattler*, the engines went away practically instantaneously—at the second stroke of the

bar, in fact—and we understand they may be relied upon to do so. They are reversed by means of an hydraulic-clutch and epicyclic-gear. A description of the reversing-gear would be unintelligible without drawings, which we hope to give on a future occasion. The principle, however, is well-understood by engineers.

The suction-producer consists of a cylindrical steel-casing lined with firebrick, and uses anthracite coal, which is admitted by means of a feeding-hopper in the water-cooled cover. The fuel rests on trough-shaped bars arranged radially, with their inner ends resting on a water-cooled tube. The steam used by the producer is supplied by "boilers" arranged one on each exhaust branch of the engine. These are casings containing a nest of tubes, around which the exhaust gases pass. Besides supplying the necessary steam, the "boilers" effectively silence the exhaust. After leaving the producer the gas passes upwards through the cooling-tower, which is simply a vertical pipe, down which water is sprayed. This cools the gas and removes dust and grit. Thence it goes to the centrifugal drier, in which a high-speed fan throws out all water, etc., which is drained away to a water-seal. From the fan it passes to the cleaner, which is a square box filled with a labyrinth of closely-packed perforated plates, upon which settle any dirt or water that may possibly have escaped the action of the drier. Thence the gas goes to the engine. Very little useful space is occupied by the washing, drying and cleaning apparatus. Other auxiliary apparatus includes a small steam-driven compressor for filling the starting reservoirs. For this and other purposes on board for which steam is useful a vertical donkey-boiler is installed.

From the brief description we have given it will be seen that the plant has been most carefully designed for the purpose in view, besides being of more than ordinary interest on account of its size and novelty. It may, or may not, be along the final lines which large marine internal-combustion plant may take; but it marks the first important step in the development of such plant. On the occasion of our visit already referred to it ran perfectly in every way, and with no noticeable noise. Externally the engine may appear more complicated than the steam-engine; but all that there is can be seen, and anything that is lost in the engine-room is more than made up in the "stokehold." The smallness of the space occupied, and the slightness of the attention required, were very noticeable, while the certainty of the absence of many of the troubles inherent in boiler-plant is no small consideration at sea. Producers, no doubt, have their faults, but they are at their best when working under a steady load, such as marine practice involves.—*Engineering.*

MISCELLANEOUS.

COALING AND COAL ECONOMY.—Of the many important arrangements affecting the efficiency of a warship, one of the most difficult satisfactorily to provide for is the reception of the coal into the bunkers, its stowage and its distribution subsequently to the furnaces. The conditions imposed by ship construction, and warship construction in particular, make the problem the antithesis of that of a shore plant where mechanical devices alone transport the coal from the railway truck to the furnaces. The subdivision of compartments so essential to the safety of a warship makes a number of coal-bunkers inevitable, and in a large vessel it is usual for there to be at least twelve bunkers—four lower and eight upper—to each boiler-room; each of these bunkers must have means of filling from above, for trimming from the upper to the lower, and to some extent for transference of the coal in a fore-and-aft direction. The number of openings in the decks and bulkheads must be as few and their size as small as possible, as they must be closed by water-tight scuttles and doors capable of being worked easily and closed rapidly, in case of collision or damage, from at least one easily accessible position. As a necessary consequence of

these conditions, the transfer of coal from a collier or from the dock-side to the bunkers is almost entirely a matter of manual labor, while the subsequent transference from bunkers to furnaces is exclusively so.

The recent increases in speed of warships and the consequent increases in power involve correspondingly greater coal consumption, and unless the speed of coaling can be augmented more time must be spent in this arduous and uncomfortable operation. In our issue of July 10 we published a report of Admiral Evans, of the United States Navy, on the fleet under his command, containing some interesting observations on the question of coaling. He considers the subject of such importance as to merit the most careful consideration, from the operation of bagging the coal to its final trimming in the bunkers. A complete review of the subject should include the design of colliers to make them fit the average battle-ship, so that the greatest number of men and hoists may work at the same time. The problem is, as Admiral Evans points out, one of great tactical importance, for a vessel during the time of coaling is not an effective unit of a fleet. In our own navy there have been many remarkable coaling performances, and much emulation exists in the ships of the various fleets to show a smart coaling record. The time taken, as shown by the returns, does not, however, represent the time during which the ship is out of action. There is the preliminary work of rigging coal-shoots, where, as in a number of cases, they are portable, and these same shoots have afterwards to be unshipped and stowed. Many of these impedimenta could not be left in place without interfering with communication along the decks, and their removal is therefore necessary before the vessel resumes her character as an efficient fighing machine. There is, further, a good deal of trimming in in the bunkers to be finished after the last bag has been hoisted on board, and this trimming must all be completed before the last of the armored scuttles can be closed.

As a moderate estimate, a battle-ship requiring to refill bunkers may be considered *hors de combat* twenty-four hours, and for at least half this time to be incapable of giving chase at full speed, while if the coaling appliances on the ship or collier are indifferent these times may be greatly exceeded. History repeats itself, and it is quite possible that under modern conditions we may see a repetition of the chase which Nelson made after Villeneuve. Absence of definite information due mainly to Nelson's lack of frigates made this pursuit abortive. In the modern instance, should it occur, coal endurance and the ability or otherwise to coal with rapidity will be the determining factors. The tactical advantage of rapid coaling which Admiral Evans emphasizes is thus very great, but except in points of detail it is difficult to see how any advance is to be made. The coal has to be bagged in the hold of the collier and trimmed into the bunkers, and while these operations are essentially manual, quickness of coaling is mainly a matter of physical endurance on the one hand and organization in the routine of shooting the coal into the various bunkers so as to avoid blocking the shoots on the other. The intermediate operation of hoisting on board can in most cases be done much more quickly by the colliers' winches than the bags can be filled or the bunkers trimmed.

As we cannot reasonably expect any great advance to be made in the speed of coaling over these obtaining at present, the questions of bunker capacity and economy of the propelling and auxiliary machinery become of additional importance. In our most recent ships bunker capacity has been largely increased, with the disadvantage pointed out by Sir William White, that the sinkage from normal to deep draft has been also increased, a rather serious disadvantage affecting the efficiency of the armor belt, but an inevitable part of the price which has to be paid for increased speed. Another factor in this problem is the use of oil fuel, the tactical advantage of which was demonstrated in the maneuvers of two years ago when the fleet under Sir William May using oil fuel easily evaded the pursuing fleet. The use of the double-bottom compartments for the storage of liquid fuel

has undoubtedly contributed to the solution of the problem of obtaining higher speeds without sacrifice of radius of action.

The question of rapid coaling, as we have shown, mainly depends upon the human element; the question of bunker capacity is one of construction which does not permit of much variation in treatment, and it is to matter of economy of fuel consumption that all such discussions must inevitably lead. The vessel with the lowest coal consumption is invariably the best steamer; she will "get there" quicker and take less time to refill her bunkers than her less economical sisters. To refer again to Admiral Evans' luminous report, he says the variable performance of the ships of this fleet would indicate that this is as much a question of economy in the design of the engines and boilers as in the actual capacity of the bunkers, and in the succeeding paragraph he refers somewhat caustically to the performance of one of his ships which has no economical speed and burns over thirty tons of coal a day in port. Coaling a vessel with such an appetite as this must, indeed, be a Sisyphean task.

It would almost appear that we have reached a limit in the economy of the main propelling machinery of warships, as the coal per indicated horse-power has been practically stationary in the last decade, while owing to the multiplication of power-driven mechanical appliances on board, the consumption of coal for auxiliary purposes has sensibly increased. In spite of the cheery optimism of some of the advocates of the internal-combustion engine, it is to be feared that the prospect of reducing the coal bill of the main engines by gas-engine propulsion is still remote; but, on the other hand, there does not appear to be any great difficulty in the way of reducing the expenditure of fuel for auxiliary purposes by employing oil or gas motors, and, in fact, a start in this direction has already been made in our own navy. The importance of economy of coal for auxiliary purposes is not often realized. In the hypothetical reproduction of the famous incident to which we have previously referred, the modern Nelson will be watching with dwindling bunkers while the modern Villeneuve is waiting his opportunity to escape, and when at length the chance arrives, Nelson may find that he has not coal enough left to give chase at full speed. To be able to coal quickly when required is good, but to be able by superior economy to outstay a rival is better; and if the former merits careful study, the question of the economy of main and auxiliary machinery deserves to be made the subject of exhausixe research.—*The Engineer.*

WRECK STATISTICS FOR 1907.—Lloyd's wreck statistics are always a mine of information to the commercial and shipping man, and an inexhaustible source of suggestion to the man who may be neither, but yet has an understanding mind, receptive to everything of interest to his country or mankind. Sea traffic is surely such a thing; it includes interests of much more moment than merely trade matters, although these enter into them, and of course it is chiefly with respect to them that we have here to deal with wrecks. The annual statistical summary of vessels totally lost, condemned, etc., is strictly a statistical and business document.

One can hardly, nevertheless, look it over without a thought of the enormous degree in which modern methods of sea transport, by increasing the size and speed of vessels, facilitating operations in port, facilitating telegraphic and postal communication and improving the the construction of ships themselves, have directly or indirectly reduced the risks which used to be attendant on all over-sea operations. The risks, in this diminished degree, still exist, and still demand and receive the attention they deserve. We would like to be able to put into some comprehensive and comprehensible form figures showing in what degree maritime risks have really been diminished, say, since the introduction of steam; but there are so many things to consider in this aspect that we will, at all events for the present, content ourselves with quoting actual facts, on the indisputable basis of Lloyd's return; here we are on safe an non-speculative ground.

It is satisfactory to see that the percentage of losses of steamers continues to decrease, both as to number and tonnage. In 1907, which, of course, is the year dealt with, the percentage was 1.76 on the number of vessels, and 1.75 on the tonnage. This is quite a considerable improvement on the averages since 1897, which were—1897 to 1901, 1.99 on number, and 2.1 tonnage; 1902-1906, 1.91 on number, and 1.77 on tonnage. It is not so satisfactory to see that the proportion of sailers lost has increased; but we must remember that it is a proportion, and not an aggregate, and that the proportion of sailing tonnage built to that of steam tonnage is always decreasing, so that the older sailers are gradually being broken up and condemned as well as lost in other ways, and still enter under those heads into the lost list. Here, again, we are tempted to enter into speculative statistics; but Lloyd's firmly, and doubtless rightly, refrain from publishing anything but actual facts; and to these we return.

The total steamer losses in 1907, "as reported to July 1, 1908," were 273 boats, of 263,613 net and 408,328 gross tons. This includes losses under the usual heads, viz., abandoned at sea (6); broken up, condemned, etc. (1); burnt (17); collision (40); foundered (35); lost, etc. (could not be otherwise classified) (3); missing (19); wrecked, stranding rocks, etc. (152). Of these 273 boats 90 were British, 19 belonged to British Colonies, 11 to the United States, 2 to Austria-Hungary, 6 to Denmark, 1 to the Netherlands, 14 to France, 27 to Germany, 4 to Italy, 27 to Japan, 20 to Norway, 7 to Russia, 13 to Spain, 7 to Sweden, 15 to other European countries and 10 to Central South America. But what is perhaps the most interesting comparison is that of the percentage of losses to the number of steamers and tonnage owned by each country. Here the U. K. figures well, and better than it has latterly done. Its percentage on number of 1.09, and on tonnage 0.95. Three countries only, Austria, the Netherlands and Italy, have better averages; theirs are as follows, giving first the percentage on number and then that on tonnage: Austria-Hungary, 0.64 and 0.91; Netherlands, 0.22 and 0.08; Italy, 1.01 and 0.59. Russia and Sweden and Denmark have averages, on the whole, about the same as ours; the U. S. A. has less on number, but much more on tonnage; and it must be also observed that where countries have only a small merchant navy, the item of chance (we must so call it) enters largely. For instance, Austria happens to have lost only two boats in all, the Netherlands only one, Italy four and Russia seven of small tonnage. Their figures, therefore, can hardly be taken as real percentages, and certainly not as averages. Of the great shipowning nations the percentages besides those given or indicated are: France, 1.73 and 1.26; Germany, 1.58 and 1.25; Japan, 3.38 and 3.15; Norway, 1.69 and 2.18; Spain, 2.78 and 3.40. Of these, it will be seen, we are much ahead in what concerns safety. Our own colonies have the figures of 1.56 and 1.58. Italy and Austria-Hungary, both with merchant navies of over 400,000 tons, may claim the maximum of safety. Steamers on the Great Lakes of America are not included. Turning to sailers, we find 367 losses; or nearly 100 more in number than steamers. Here we find very remarkable figures. England lost 41 vessels; British Colonies, 29; the U. S. A., 94; France, 22; Italy, 20; Norway, 84; Russia, 20; Sweden, 25; other countries a few each. Again taking percentages first of the number of vessels, and then of the tonnage owned by respective countries, we find Germany, Italy and Austria-Hungary at the top, with 1.31 and 1.70, 2.82 and 3.01 and nothing, respectively, but here Austria should not count, as she had no losses out of only 14 sailers owned, while Italy owned 710. The U. K. has the figures of 3.35 and 3.09; her colonies rather more; the U. S. of America 4.86 and 4.83 (on the largest sailing fleet of any). France, Denmark, Russia, Spain and Sweden, approximate to our own figures; but Norway, with the heavy number of 980 vessels, and the third largest sail tonnage of any country, has the startling, and indeed tremendous percentage of 8.57 on number, and 8.16 on tonnage—nearly double that of America, the runner-up in losses, and more than double that of our and other great

maritime countries. Germany thus has the best figures; she lost but 5 vessels out of 381 owned. Japan does not figure in the sailing vessels table.

We need not go into particulars of that showing the steam and sail losses combined; but, perhaps, as interesting as the number of losses, is their cause. Here we cannot usefully shorten, or do better than quote, the remarks appended to the publication of the tables by *Lloyd's Register* itself:

"The summary exhibits interesting data as to the relative frequency of the different kinds of casualty, etc., which conclude the existence of vessels. Strandings and kindred casualties, which are comprised under the term 'wrecked,' are much the most prolific cause of disaster. To such casualties are attributable 42.7 per cent of the losses of steamers and 35.7 per cent of the losses of sailing vessels. The next most common termination of a vessel's career is by condemnation, breaking up, etc., 23.6 per cent of the steamers and 34 per cent of the sailing vessels removed from the merchant fleets of the world being accounted for in this manner. Of the remaining causes of loss, collision is the most general for steamers (11.2 per cent); while, for sailing vessels, cases of abandonment at sea come next in order of frequency (8.4 per cent).

"The percentages just given are based on the present return alone, but the order of frequency of the several classes of casualty appars to be normal. Cases of abandoned, foundered and missing vessels are no doubt frequently more or less similar in the circumstances of loss. If these be taken collectively, they comprehend 16.9 per cent of the steamers, and 20.1 per cent of the sailing vessels removed from the mercantile marine during 1907."

There is another thing to be considered in this connection, namely, the nature of the trade in which the vessels are engaged. Thus, the Norwegian sailers go all over the world in various trades, while the Americans are confined more to certain special routes, and so on. These things cannot be tabulated; but they affect the fairness of a comparison between the percentage of loss of the various nationalities. So also do such facts as the nature of the vessels themselves. Japan and Norway, for instance, might be expected to have their percentages of losses of steamers increased because they are buyers of second-hand, and therefore less seaworthy vessels, than those running under our own flag, which latter are always being increased by new and improved boats, while the older ones are weeded out by sales as well as by losses. This again cannot well be tabulated.—*Shipping World.*

THE REASON WE DROWN. By Woods Hutchinson, A. M., M. D.—One of the oldest and most painfully familiar facts of human history is that we drown whenever we fall into the water and sink. And the explanation of this distressing result is equally ancient and familiar; we die because our lungs fill up with water. So obvious and self-evident was this explanation that, like so many other universally accepted and self-evident things, it was never, until lately, put to an accurate, scientific test. The not unusual result of the test was to show that the ancient explanation is almost entirely wrong.

A few years ago a scientific commission was appointed by the English government, headed by Professor Schaefer, of Edinburgh, for the purpose of determining the best method of resuscitating those apparently drowned. The first thing that confronted this body was the fact that we were entirely ignorant as to exactly how death by drowning was caused. The commission proceeded to determine this fact.

A thorough and elaborate series of experiments on animals were carried out, with some distinctly interesting and valuable results. First of all, it was found that death by drowning is not due to the filling of the air passages with water, as many of the animals experimented on were found, upon examination immediately after death, to have drawn into their lungs water in amounts ranging from four to eight ounces only (from one-third

of a cupful to a cupful. In some instances, death occurred when only two ounces of water had been drawn into the lungs.

Two Chief Causes of Death.—The chief cause of death appeared first to be a curious inhibiting or paralyzing effect upon the heart. This was quite apart from the direct effect upon respiration, so much so that it could actually be prevented by administering a drug (atropin), which stimulated the heart, and prevented the transmission of this curious reflex paralyzing effect. As Professor Schaefer dryly remarked:

"If you are quite sure you are going to be drowned, it is a good thing to take a dose of atropin in advance."

The second chief cause of death appeared to be a profuse pouring out of mucus, which occurred from the throat, windpipe and lining of the bronchial tubes. This, by the violent efforts at inspiration, rapidly becomes churned into a froth, plugs up the smaller air-tubes and air-cells, and renders it almost impossible to get air into the deeper parts of the lungs. This accounts for those puzzling cases in which individuals were got out of the water in a very few seconds after breathing had ceased and yet ultimately died, in spite of everything that could be done to resuscitate them. They were literally choked by their own secretions, drowned in their own mucus. Even the small amounts of water taken into the lungs were found to either be coughed out again directly, as soon as the passages were cleared, or to be promptly absorbed into the blood vessels.

This gives us the important practical knowledge that *there is no need to waste any time in standing the victim on his head, or rolling him over a barrel, or shaking him, head downward, in order to "get the water out of his lungs."* Such procedures are a sheer waste of invaluable time.

Next, experiments were made as to effective methods of performing artificial breathing, and its was soon found that these were of such a character that they could be carried out upon a living human subject. Volunteers were found who would put themselves in the hands of the experimenters, draw three or four full breaths, then completely relax and make no effort at breathing while the experiment was carried on. A tube connecting with a spirometer was placed in the mouth, and then the various standard methods of producing artificial respiration were tried upon them, and the actual amount of air which could be forced in and out of the lungs carefully measured for the first time in the world's history.

It was found that out of the three generally accepted methods of artificial respiration, the so-called Marshall Hall, the Sylvester and the Howard, the first two were utterly inadequate, and the third dangerous. By no possible vigor and skill at manipulation could the volunteer subject have enough breath pumped in and out of his lungs by either the Marshall Hall (which consists of rolling the body from the side over on to the stomach and back again in rapid succession) or the Sylvester (the well-known pulling the arms up over the head and then pressing down firmly again on the chest) to keep him in any degree comfortable. The Howard method, which consists of compressing the sides of the chest with both hands at regular intervals, allowing it time to expand, while it would effect a nearly sufficient interchange of air, was found to be fraught with some danger to both the ribs and the liver, on account of the force necessary to be used, while from the fact that the patient lies upon his back the tongue is almost certain to fall back and produce suffocation; or such fluid, water, and mucus as may be present in the throat will accumulate there and prevent the entrance of air.

After many trials a method was hit upon which avoids all the dangers of the old methods and is so strikingly effective that perfectly healthy individuals submitting themselves to it can be kept comfortable for not merely minutes, but hours at a time, without having to make the slightest voluntary effort of their own at breathing. Indeed, Professor Zunst, who eagerly submitted himself as a subject for demonstration at the last Congress of German Physiologists, denounced, with mock solemnity, the use

of the method as subversive of good morals, because it makes it possible for the individual who is literally "too lazy to breathe" to go on living. The method, fortunately, is simplicity itself, and very easily carried out:

A Complete Change in Rescue Methods.—The individual whom it is desired to resuscitate is promptly, and without a moment's delay in either loosening clothing, drying, warming or shaking the water out of the lungs, turned upon his stomach upon the shore, or other level place, the face being turned to one side so that the nose and mouth are clear of the ground. Then the operator kneels, either by the side of or astride of the patient's hips, facing toward his head, places both outspread hands upon the small of the back, just over the shortest ribs, and pitches his body and shoulders forward so as to bring the whole weight heavily upon the body of the victim. This downward pressure should take about three seconds. *He then swings upward, lifting his hands off suddenly and quickly.* The elasticity of the ribs and of the contents of the abdomen cause the chest to expand. *In three seconds more the process is repeated, and so on, indefinitely, making ten or twelve of these movements per minute.* The position allows the tongue to fall forward, and any mucus or water which may be present in the lungs to readily escape through the mouth. By simply swinging backward and forward, throwing the weight of his body upon the waist line of the victim, any operator of modern intelligence and most moderate strength, even a delicate woman or a child, can gain a sufficient inflow of air, flowing in and out through the lungs of the patient, to supply him with as much air as would be taken if he were able to breathe voluntarily. Promptness in beginning the pumping operation is imperative. Professor Schaefer's experiments proved that conclusively.

This method, which has only recently been thoroughly worked out, has been adopted by the Royal Humane Society of England, the Royal Life Saving Society and the Coastguard Service.—*Collier's Weekly.*

A SUBMARINE SIGNALLING EXPERIMENT.—An interesting and successful trial of submarine signalling by the French Admiralty was made off Quiberon last month, the operations being conducted on board the battle-ship *Léon Gambetta*, under the supervision of a committee presided over by Admiral Jaureguiberry. The trial, which was based on the Submarine Signal Company's system, consisted in noting at what distance and how correctly the position of the signal-bell could be located with no aid beyond that afforded by the receiving instrument. A torpedo-boat, with the signal-bell, having been sent out to an anchorage about three miles from the shore, the *Léon Gambetta* steamed out to her. Mr. J. B. Millett, vice-president of the company, with his engineer and the members of the committee, were locked in the chart-room, where the receiving instrument was fixed; but they were without chart or compass, and all the windows were obscured. Admiral Jaureguiberry remained in a room adjoining, while the captain of the ship took up his position on the bridge, which was in communication with the chart-room by means of a speaking-tube. The *Léon Gambetta* was then taken nine miles from the torpedo-boat, when she stopped, and the supposed position of the bell, as located according to the tones coming through the receiver, was noted by those in the chart-room. The ship steamed a further distance of about three miles, and the supposed position of the bell was again recorded. The *Léon Gambetta* was then maneuvered in various directions, the course with respect to the position of the bell being noted from time to time by those in the chart-room. Finally, Mr. Millet was asked to give instructions for navigating the ship so that she would head direct for the torpedo-boat, and this he succeeded in doing with precision, steering her by the sound alone right on to the bell within 150 yards. In every instance the positions noted by those in the chart-room were found to correspond with those made on the bridge. The accuracy with which the position of the bell could be determined has given great satisfaction to the French naval authorities.—*United Service Gazette.*

NAVAL SECRET-SERVICE EXPENDITURE.—The Return of Naval Expenditure by the principal Naval Powers of the World during the last ten years is a document worth studying, if for no other reason than that it affords an object lesson of the enterprise of other nations in spending money freely in order to ferret out one another's naval secrets. This, of course, is classed under the heading of secret-service expenditure, but the particulars given in this respect refer to Russia and Japan, who appear to be the only two nations who have no desire to keep from other powers the knowledge of the amount of money they expend every year for secret-service aims. Japan appears to have been the most lavish in this respect, having expended £5000 in 1906-7, £8000 during 1907-8 and a similar sum during the present year, 1908-9. Russia, though equally as candid as Japan in publishing her secret expenditure, has only made a start this year by voting £9562 for secret-service purposes. No particulars are given of Germany, though we may be quite sure, in view of her shipbuilding activity, that she must have spent large sums for this particular service. The same thing may be justly said of Great Britain, though "secret-service money" is a phrase that is taboo in British service circles, and is popularly supposed to be as dead as the dodo. No doubt, however, the Naval Intelligence Department could throw some light on this somewhat abstruse subject.—*United Service Gazette.*

The temporary installation of a system of wireless telegraphy on the roof of the new Admiralty buildings in Spring Gardens, is being replaced in a permanent form on the three great towers overlooking Horse Guards' Parade. It is interesting to relate that during the great Napoleonic war there was fixed on the top of the old Admiralty buildings in Whitehall a semaphore or telegraph, by means of which, on a fine day, messages could be sent in an hour to Portsmouth and one or two other stations. The semaphore was first adopted by the British government in 1795, and remained in use until the middle of the nineteenth century. Some of the older generation of Londoners will remember the lofty building known as "Watson's telegraph to the Downs," which was established in 1842 in the neighborhood of Tooley street, for the purpose of connecting London and Deal with the semaphore telegraph. This station, together with St. Olave's Church, was entirely destroyed by the disastrous fire in 1843, when Superintendent Brade lost his life.—*United Service Gazette.*

One of the most interesting operations ever witnessed in Liverpool docks was completed when the steamer *Transporter* received into her hold the second of two submarines built by Vickers, Sons & Maxim, at Barrow, which are to be conveyed to the East for the Japanese government. The port bulwarks of the vessel, together with the whole of her hatches, were removed as she lay in the Queen's graving dock, and in her hold two berths with chocks were prepared for the reception of the submarines. Special manholes in her bottom were thrown own, and as the water was pumped into the dock the craft became submerged until only her bridge and funnel remained visible. The submarines were then brought into the dock separately, and as the water was pumped out again, divers who were below aided in guiding the submarines into their berths, where they were securely fixed for their long voyage. The ship will proceed to Barrow to be finally fitted out for her trip.—*United Service Gazette.*

The Submarine Signal Company have in hand the equipment for an electrical submarine bell for installation at Tarrifa. This will be the first electric bell to be fitted on this side of the Atlantic. It will be worked by a dynamo in the lighthouse at Tarrifa, with a cable extending a quarter of a mile off the shore into 20 fathoms of water, the action of the hammer being controlled by powerful electric magnets inside the bell casing. Similar electric bells which have been fitted on the Canadian coast have

given entire satisfaction. The code of signals for the bell at Tarrifa is awaiting the approval of the Spanish Minister of Marine.—*United Service Gazette.*

Some important experiments have been carried out near Portsmouth, England, with Colonel Cody's man-lifting kites. Three kites were tested, and in the lower was a wicker basket for the observer, who, by means of a telephone, could communicate with a warship below, to which the kite was held captive. Three destroyers assisted in the experiments which took place in the Solent with very satisfactory results.—*United Service Gazette.*

The new White Star liner *Olympic*, of which the keel-blocks have already been laid by Messrs. Harland & Wolff, is to have a displacement of 60,000 tons. The second of the new mammoth liners is to be known as the *Titanic*, and on these two vessels £3,500,000 is to be spent.—*Page's Weekly.*

BOOK NOTICES

"Nautical Charts," by G. R. Putnam, M. S., member of the American Society of Civil Engineers, director of Coast Surveys, Philippine Islands, 1900 to 1906. Contents—List of Books or Papers bearing on Nautical Charts and related Subjects. Charts and Maps. Collection of Information for Charts. Preparation of Information for Charts. Publication of Charts. Correction of Charts. Reading and Using Charts. Use of Charts in Navigation. Publications Supplementing Nautical Charts. Index. 8vo. viii + 162 pages, 49 figures. Cloth, $2.00 (8/6 net). New York: John Wiley & Sons. London: Chapman & Hall, Limited, 1908.

Although nautical charts are mentioned or discussed in many publications, there has not been one hitherto which covered the general subject of their origin, construction, and use. In the countries of the world more than a million copies of such charts are now issued annually. A considerable portion of the human race is interested directly or indirectly, whether as mariners or passengers or shippers, in navigation upon the sea. Aside from supplying a handbook for those who have a general interest in the subject, a discussion of charts may lead to further consideration of the principles governing their construction.

The book has intentionally been made as non-technical as seemed feasible in treating a somewhat technical subject.

A brief historical sketch is given of the development of map and chart making. The present governmental activities in this work are outlined, and the purposes and principles of charts are described.

The next chapter deals with the collection of the information on which charts are based, with brief explanations of the surveying operations required. This is followed by a description of the preparation of charts in the office, and of the methods of publication and correction.

The two following chapters are on the reading of charts and their use in navigation, and the final chapter tells of the various publications supplementary to charts.

"Ex-Meridian Altitude, Azimuth and Star-Finding Tables," with Diagrams for Finding the Latitude and Facilitating Plotting Lines of Position and Giving New and Practical Methods for Identifying Stars in Cloudy Weather, Latitudes 0°-65°; Declinations 0°-71° North and South, by Lieut.-Commander Armistead Rust, U. S. N. 8vo, li + 393 pages, 13 figures, including 6 folding plates. Cloth, $5.00 (21/- net). New York: John Wiley & Sons. London: Chapman & Hall, Limited, 1908.

These tables are so arranged that the "Reduction to the Meridian" may be found with sufficient accuracy for practical navigation, at one opening of the book, while means are provided for readily obtaining the azimuth and correcting the "Reduction" for variations in all of the elements when extreme accuracy is required.

The "Reduction to the Meridian" may be used for finding the "com-

puted zenith distance" in Commandant Marcq Saint-Hilaire's method for plotting lines of position, which may be found fully described in various text-books on navigation.

The attention of navigators is invited to the method given in this prospectus for the identification of stars and the examples on page xx. This is so simple and easy of application that it must find favor with practical navigators.

Under certain conditions when a body is near the meridian the azimuth changes very rapidly and may not be readily obtained either from tables or by observation; at such times the rules given will be found most useful and will enable the lines of position to be plotted with ease. The method for plotting the lines of position without using the compass rose or parallel rulers will be appreciated by seamen.

As the "Second Reduction to the Meridian" is easily obtained from Plate I, the value of the "Reduction to the Meridian" may be found for limits far exceeding those given in the tables.

A new formula for the "Equation of Equal Altitudes" for finding the chronometer error, deduced by Mr. G. W. Littlehales, will be found more convenient than that in general use, and the formula given for finding the longitude from Ex-Meridian observations has, it is believed, been reduced to such a simple form as to make it most useful when the weather has been too cloudy to obtain the longitude in any other way, or when the ship is in a region of strong currents.

The values of the "First Reduction" are given for intervals of four minutes of hour angle for each degree of declination and latitude from 0 to 65 North and South and 0 to 71 of declination, also the change in altitude in one minute from Meridian Passage with its logarithm, the "Limiting Hour Angle" and the Meridian Altitudes up to 85°.

"The Transmission of Military Information." By Lieut.-Colonel George P. Scriven, Signal Corps, U. S. A.

This is a most interesting collection of papers written to cover the whole subject of the transmission of military information. The separate parts into which the book is divided were evidently prepared at different times and intended to be complete treatises in themselves, which may account for the lack of continuity noticed and the consequent repetition of salient facts. The whole subject of visual, sound and the various forms of electrical communications is thoroughly dealt with from the standpoint of the mobile army on shore, but what should be most interesting to naval officers is the part devoted to the various means of controlling and checking gunfire at coast defense stations. It appears that all this complicated and delicate apparatus is installed by one corps of the army, the Signal Corps, and is then actually operated by another arm of the service, the artillery. It would seem more reasonable that those who are to use the instruments should be intrusted with their installation, as they would be more familiar with the intricate parts and could more readily repair breakdowns. Ability to repair is quite as much to be sought as ability to install.

In such a complete collection of papers, designed to describe the various methods of collecting and transmitting information, it is a matter of some

little surprise that the military use of the dirigible balloon and aeroplane is not considered to any extent, for though the means of locomotion may not as yet be perfected, their purposes should be well known and defined and methods of conveying information through wireless telegraphy or by line telegraph from the captive balloon should have passed the experimental stages.

The use of kites to support cameras for taking photographs might also well have been referred to as a means of obtaining information. Cameras supported by kites at altitudes of 800 to 1200 feet may obtain photographs of hidden fortifications and reveal the presence of an enemy when all other means fail. Photographs as long as three feet have been obtained at distances of ten to twelve miles which readily show objects hidden from land.

But despite these minor omissions, Lieut.-Colonel Scriven's work will be found both interesting and valuable.

Published by the "Journal of the Military Service Institution of the United States," Governor's Island, N. Y.

Lieut.-Commander Beach's second story, "An Annapolis Youngster," in our opinion, is the best story yet written of midshipman life. There is not a dull page in it, and it is true to the facts. It abounds with professional knowledge most cleverly used. It is very difficult to amalgamate incident and machinery, rigid routine and the spirit of fun and adventure. A Kipling is required to do this with the touch of genius, but Mr. Beach has done it remarkably well. Most stories of midshipman life are trifling, but this story has a serious and high purpose. It deals with work, not bunting; it is a tribute to routine, not round dances. Its ideal of character is fine, and it lives up to it. The story begins with the summer practice cruise. One thrilling adventure, or misadventure, stirs up tremendous excitement. Robert Drake, the hero, gets shut up with Chief Water Tender Patrick Flannigan in coal bunker C24 for 35 hours. How they escaped is a new chapter in rescues. Robert's method of making their whereabouts known is as novel as it is exciting. It shows inside knowledge of electricity. Whoever would have thought that by the simple aid of a jack-knife a thermostat could be put to a wholly original use in signaling? Yet by a new use of the thermostat Robert calls up the commanding officer and sets the whole ship's company on the run for his deliverance. Flannigan is a superb Irishman. His brogue is good, and Mr. Beach has a real knack in spelling it. The story could not have done without Flannigan. In the coal bunker Robert's person was in danger of ultimate carbonization; but his worst moments there were as nothing compared with other kinds of danger that beset his reputation. His honesty and fearlessness in the performance of duty made mortal enemies of two of his classmates, Williams and Ramsay. The grudges and enmities of these young miscreants soon ripened into maliciousness. The practice cruise and the September leave over, they conspired with a second classman named Foster to plunge Robert into the worst troubles possible in midshipman life. Foster had no grounds for his malice; but was a man whose piques turned to hatreds. Difficulties thickened for Robert. He was a member of the Academy eleven. Williams, his opposite on the

second team was guilty of the most dastardly and covert treachery toward him, and gets paid with a blow that shook his timbers to their last fibers and stretched him unconscious on the turf. Without permitting a word of explanation, the captain of the team ruled Drake off the field, and disgraced him in the eyes of the whole Academy. One thing follows another until Robert is so unpopular that his class puts him in coventry. He bears his various trials with great fortitude and principle. Meanwhile friends are at work for him. Little by little they unearth the plot of the conspirators. It is a dark one, but no darker than the occasional reality. The hero bides his time, does not moan nor groan, gets to the top in his studies, surprises his classmates by his ability, wins the highest respect of the officers in discipline, is noted with admiration by the commandant of midshipmen, who lets him work out his own salvation, and finally comes to the standing that such characters are bound to achieve. With Williams, Ramsay and Foster flung over the battlements of the Naval Academy heaven, that is, allowed to resign, we feel inclined to apostrophize Justice! There is a young lady in the story, the commandant's daughter. Robert bashfully dines and talks and walks with her. Their interest in each other we feel sure is the first faint flush of a honeymoon that will rise in some other story. We warmly commend Mr. Beach's story to old and young.

H. H. CLARK.

"From Keel to Truck." By Captain Paasch. De la Quille a la Pomme du Mat. Dictionnaire de Marine. Anglais-Francais-Allemand-Espagnol-Italien. Fourth edition, revised and completed: In English and French, by Captain Pierre Challamel; in German, by Captain F. E. Matthiesen, Director of the Naval School at Hamburg, and by Captain August Budde, Professor in the School of Navigation at Hamburg; Spanish translation by Admiral P. Montojo, of the Royal Spanish Navy, formerly Commander-in-Chief of the Squadron of the Philippine Islands; Italian translation by Giuseppe Romairone, Official Translator of the Civil Tribunal of Genoa. Published by Augustin Challamel, Rue Jacob, 17-Librairie Maritime et Coloniale. 1908.

The first edition of this work, entitled "From Keel to Truck, Dictionary of Naval Terms, in English, French, and German," appeared in 1885. The author, H. Paasch, was well qualified for his task, as he had had "35 years of continuous practice, including the command, and, subsequently, the superintendence of the construction and repairs of steam and sailing vessels, as surveyor to such an eminent institution as 'Lloyd's Register,' aided by an acquaintance with several languages." On the appearance of the first edition of 5000 copies, a well-known London publisher wrote to the author, "Although I recognize the value of your book, I sincerely hope that you have not been put to any expense by its publication, because you would lose your money." This prediction did not come to pass. The edition was quickly bought up in England, Europe, America, Africa, China, Japan, and the Indies.

At about the time the third edition was issued, Admiral Montojo informed the author that, in case it was desired to add Spanish, he would give the work of translation his whole attention, and would do it with the

utmost care. At about the same time, M. Giuseppe Romairone, Official Translator of the Civil Tribunal, and of the Chamber of Commerce of Genoa, wrote to the author: "I have never in my life seen such an astonishing and complete collection of nautical terms; and I would be much obliged to you if you would permit me (with the assistance of several specialists) to translate your work into Italian." He added that, in making this request, he was not prompted by the hope of making money; and that his only aim was to put the precious contents of the work at the disposition of his countrymen, in their own language. These offers were accepted, and the results embodied in the 4th edition.

Captain Paasch died suddenly, while engaged in correcting and perfecting his work. He had accumulated many notes necessary to bring the book up to date in a 4th edition. Captain Pierre Challamel undertook the task of putting these notes in order, and completing them, and also of revising the book in English and French.

The present edition is a monumental work; as the table of contents shows:

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It must be remembered that the merchant ship is dealt with, and not the man-of-war. There are very few electrical terms; and practically no terms that are peculiar to the man-of-war, such as ordnance terms, those relating to strategy, tactics, etc. Within its limits, however, the book is wonderfully complete. H. F. BRYAN, Lieut.-Comdr., U. S. N.

The S. Obermayer Company, of Cincinnati, Ohio, have just issued a fourth edition of their General Catalog No. 40. This catalog contains a number of additions and corrections, and in its 369 pages there is a world of valuable information for the foundryman. A copy may be procured by application to the company.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL, AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

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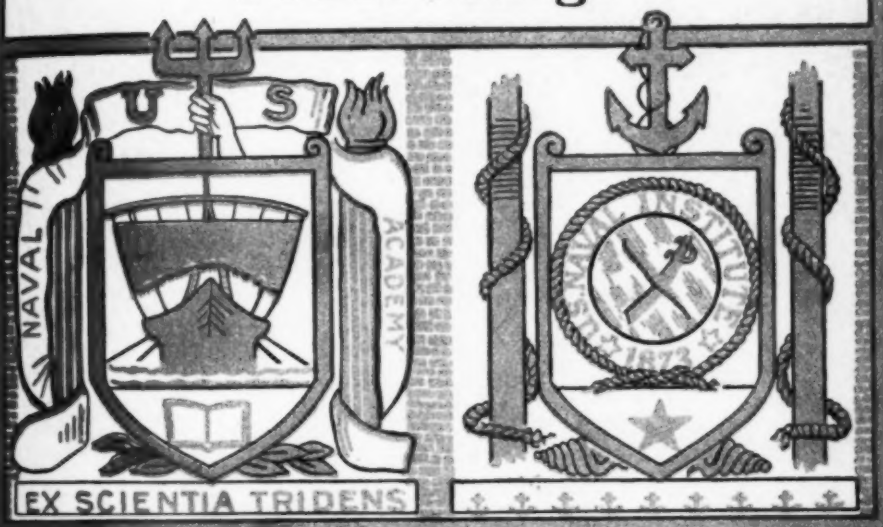

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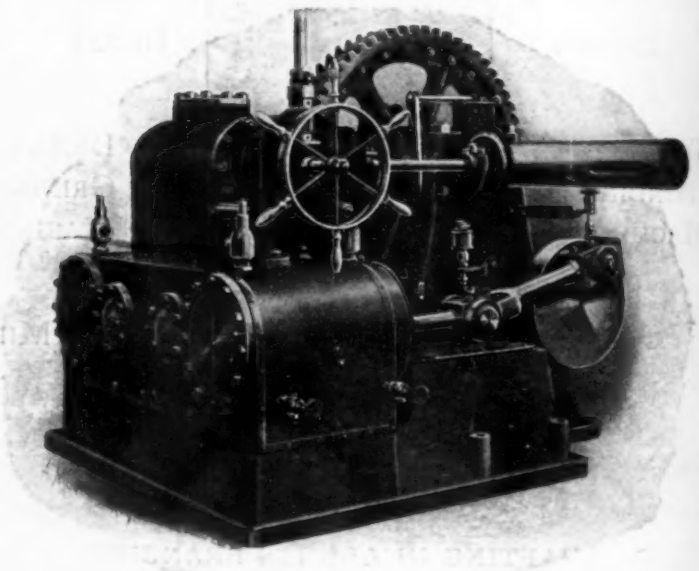

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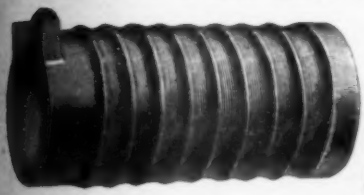

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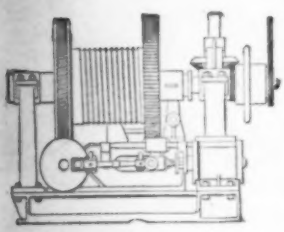

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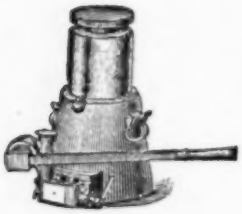

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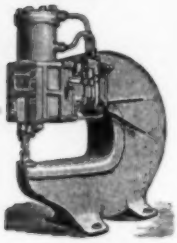

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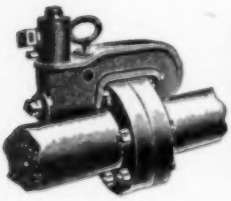

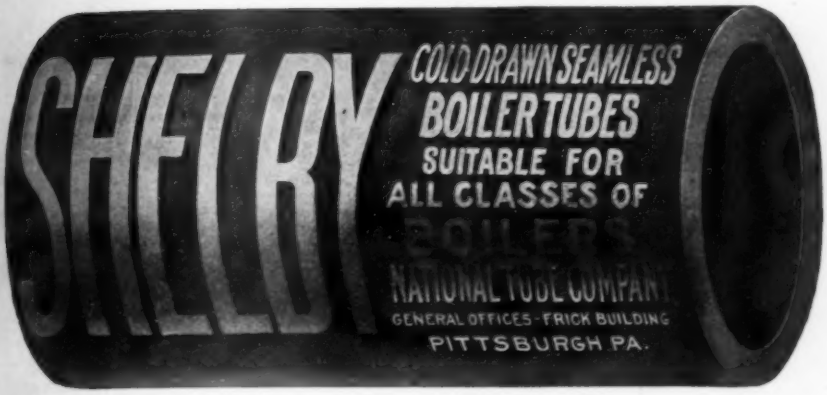

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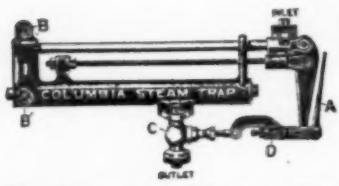

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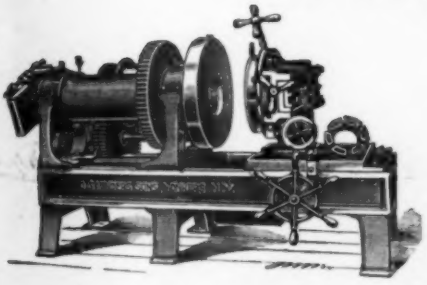

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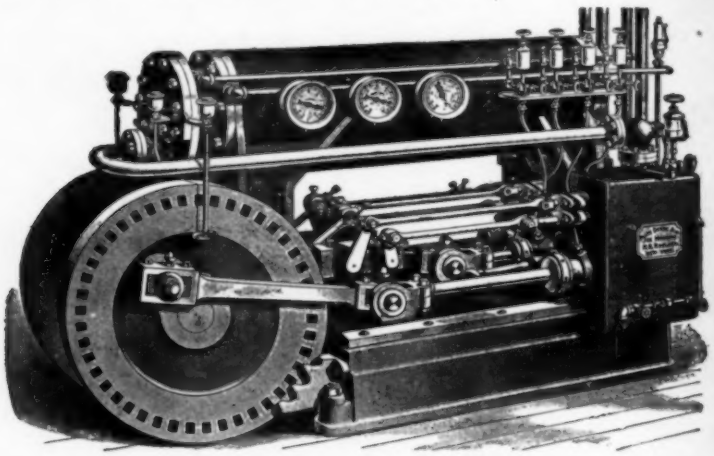

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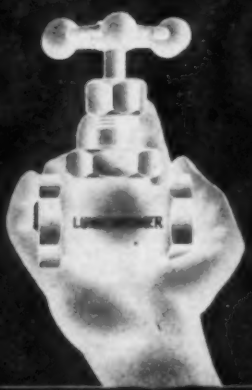

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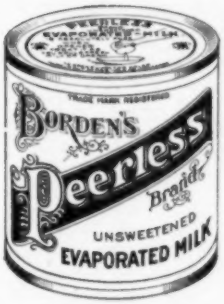

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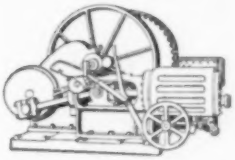

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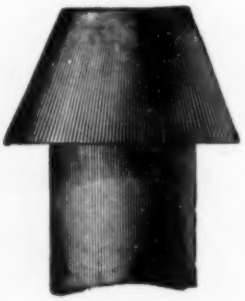

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